CHEMISTRY

50¢

Who Will Be Out of a Job?

➤ THE SCIENTIST is the one who must take the long look ahead. No matter what the temporary expedient, time as he counts it is running out. We are about to see a shift in our way of living that will be as much of a challenge as was the discovery of fire or the invention of agriculture. We are going to have to stop drawing on our inherited energy account, saved through the millenia in the form of fossil fuels, and put our machines on a current-income basis. We shall have to use day-to-day sunshine as our power source.

At the Madison conference, reported in this issue of CHEMISTRY, the scientists who can assess the future in terms of trends already familiar were not pessimistic. They believe mankind will meet the coming challenge. They say we can already cook our meals and heat our houses by sunlight, in certain localities, by using methods we already know.

Nor do the scientists think we must sink back into an era of toil and drudgery as our hoarded sources fail. We already have factories that turn out almost automatically the materials on which we depend today. If our inventive genius can keep pace with our need for the energy to keep these plants running, the transition to the era of solar power may not be too rough.

But the new age is not for the lazy. Push-button management of the power plants of the future may look simple, but the instrument man and the new technician must be on the job. What they avoid in the physical discomfort of old-time furnace tending they must make up in alertness and understanding.

If the present trends continue, opportunity for tomorrow lies in the race between invention and stagnation. Those who can meet the challenge offered by our dwindling resources have many opportunities for research. Photosynthesis needs to be solved. Nuclear energy needs to be tamed. Particular properties of matter need to be adapted to special use. People need to learn that they cannot afford the luxury of war and waste.

The challenge of the future offers a special reward for young scientists. Those who can master the new techniques now will be the ones toward whom the world will turn for solution of fuel problems which may be acute before the beginning of the year 2000.

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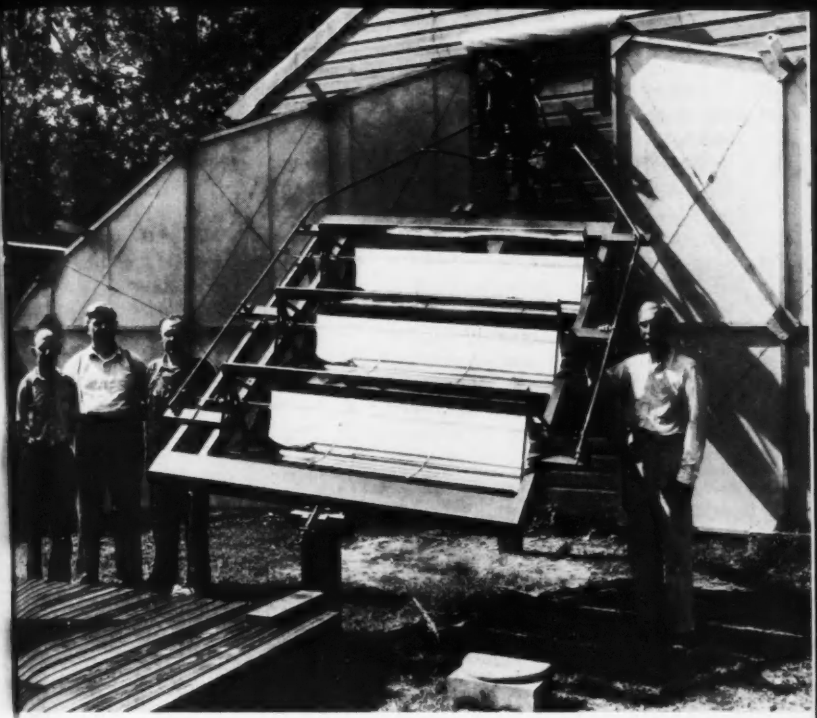


▸ GRANDDADDY *of Solar Furnace of the Future? Dr. C. G. Abbot (right), world famous astrophysicist, of the Smithsonian Institution, began experiments in 1915 which led a decade later to this solar cooker built at Mt. Wilson Observatory, California. Later, more advanced designs by Dr. Abbot and others are bringing practical utilization of solar energy closer to reality, particularly to warmer parts of the world.*

Energy For the Future

by HELEN M. DAVIS

▸SCIENTISTS are taking a long look at the energy available to the earth. They look to the sun. They assay the power locked up in the atoms of uranium. They assume the fuels we use so profligately today will not last long.

It is certain that the era of scarcity of energy and fuels is already upon us. Not at some hypothetical future time far ahead will we find our supplies short.

This was made clear at a recent conference held at the University of

Wisconsin of 43 carefully picked scientists, among them some from India, Cuba, and other nations more power-lacking than the United States.

Scientists measure the constantly increasing rate at which we are using up our resources. They can already project this rate line to find the year when we can no longer sustain this rate of living. The end will come within the lifetime of the children living today, if our increasing demand for power and our increasing birth rate keep building up as they are today.

This does not mean that the human race is in danger of starving. That end-point is much farther in the future. But it does mean that our fuels, for both heating and transportation, will be gone in their present form. Other fuels will be available, but they will cost more.

We have been increasing the rate at which we use up our fuel stores by 3% each year since the beginning of the industrial era. This figure is reported to the symposium by Palmer Putnam, who has just completed a survey of our energy resources for the U. S. Atomic Energy Commission.

Faced with such a rate of expenditure, a hypothetical trustee for the resources of the planet would want to know what banks of energy there are that we may have to drawn on for the future.

There are conflicting claims for the amount of reserves of coal and oil still to be brought into use. But these figures do not alter the picture greatly, for new supplies from inaccessible places mean higher transportation costs. The time when fuel costs reach a figure twice as great as the cost in 1953 will be the critical point in our economy, as foreseen in this study.

The liveliness of our present economy, Mr. Putnam believes, is directly related to the cheapness of our fuel. Even now, he finds the United States economy good, at our present rate of fuel use, but that of Europe faltering. At the same time, as other countries increase their industrialization and as our technical assistance program becomes more fruitful, the growth of the per capita demand for energy, all over the world, will increase. Compared with the present increase in demand in this country of 3.4%, the increase in the Soviet Union is now 5.6%. Such per capita increase, combined with the probable increase in world population, will see our fuels exhausted in 60 to 75 years.

New sources of energy will come into the picture before that time. We need but a 30% increase in the price of petroleum to bring fuel from oil shale onto the market. At twice present day fuel costs, according to Atomic Energy Commission estimates in the light of present knowledge, nuclear fuels will enter the energy picture in abundance. At about the same time it will be necessary to draw on the energy poured so lavishly on earth's surface by the sun. Experts disagree as to which will come sooner into common use.

In making calculations about energy requirements of the world, scientists find the B.T.U., the unit for ordinary calculations, too small. One B.T.U. (British Thermal Unit) is the amount of heat required to raise one pound of water one degree on the Fahrenheit scale. To raise one pound

of water from freezing to boiling requires 180 B.T.U., and 970 additional units of latent heat are necessary to boil off this quantity of water. The amount and cost of the fuel necessary to do this can be measured. When this amount of steam is condensed, 970 B.T.U. of usable heat is recovered.

To bring these calculations up to quantities that apply to the number of people in the world, the figure 1 followed by 18 zeros is used as the unit, a quantity written as the letter Q. Comparing amounts and values of fuels over a period of years, scientists predict that when present costs of fuels have doubled, the total energy used by earth's inhabitants will have reached 27 Q. When the cumulative usage reaches 575 Q, the Atomic Energy Commission forecasts uranium fuel to be an important energy source at a cost of less than 15 mills ($0.015) per kilowatt-hour. Such a usage can continue only 150 to 175 years, according to this estimate, before it will be necessary to convert at least 1% of the sunlight falling on the total surface of the earth into usable energy, if our descendants are to continue to live in the style to which we are accustomed.

From the standpoint of the utilization of really large amounts of energy, the world has just begun. The energy before the blossoming of the industrial revolution was negligible in terms of this gigantic Q unit.

In the 90 years between 1860 and 1950, only 4 Q were used by the world. The rate in 1947 was 0.1 Q annually and the rate is now 10 Q per century.

If the advice of the scientists is not heeded, our economy will no longer be lively, our population will cease its growth. The symposium for the utilization of solar energy in Madison, Wis., was not interested in such a pessimistic outlook. Its members agreed that, although we have at the most a 3,000-year reserve of coal, oil and gas within the earth, this reserve will never be used up.

Before the point of 27 Q demand, these scientists believe, before present fuel costs double, we will be using other sources of energy which scientists already are working to make available when needed.

Dr. R. A. Morgen of the National Science Foundation explains that if cost were no object we could have our homes heated by the sun's energy now. The difficulties are mainly of an engineering nature. We need better ways to store the sun's heat, to equalize the intermittent nature of sunshine. But for the sunnier parts of the world, solar heating is already practical to some extent. Solar water heaters are practical in Florida, not in California. Solar cooking is practical in India, not in the United States. But for the world in general, solar heating is possible in 100 years, on the basis of what we now know.

Dr. Maria Telkes of New York University and Dr. H. C. Hottel of Massachusetts Institute of Technology have experimented with solar heating of a full-scale experimental house. While refusing to venture any estimate of what it would cost to duplicate the installation already made, they feel that it is time for some industrialist with a pioneering spirit to take their data as the basis for some mass-production cost studies for solar heat-

ing devices for the southern part of the United States.

One of the participants in the symposium, Dr. C. G. Abbot, who recently retired as Secretary of the Smithsonian Institution, was honored by the group for his early solar cooker, built at Mt. Wilson Observatory in California in 1915, and used there by Mrs. Abbot for preparation of their meals. Many technical improvements since that time have solved some of the difficulties encountered in that venture, Dr. Abbot pointed out.

Two ranges of forecast must be considered, in the words of Dr. Farrington Daniels of the University of Wisconsin, who brought together the scientists who attended the symposium. One range includes plans for meeting the problems of the next hundred years. The other has to do with speculations covering the next thousand years. We must make these plans, or our descendants will curse us for having used up all their coal, gas and oil.

Water Shortage in Flooded Plants

➤ "WATER, water everywhere, and not a drop to drink" is actually the state of affairs which makes tobacco plants wilt, or "flop" as farmers say, after flooding. Botanists at Duke University have found this out.

Wilting, which has always been a big worry to tobacco growers, is caused when sudden saturation of the soil stops the aeration of the roots of the tobacco plant. While cut off from their oxygen supply, the plant roots are exposed to an excess of carbon dioxide. All this abruptly decreases the permeability of the roots to water. Thus the plant nearly dies of dehydration while surrounded by water.

In their experiments on the damage of flooding to the plants, the botanists, Drs. P. J. Kramer and W. T. Jackson, found that after only an hour of flooding the rate of water intake of the roots fell 60% below the rate after 15 minutes of flooding. On the farm, wilting often occurs within an hour after the soil is saturated if the rain is followed by bright sun. If the flooding does not last more than several hours, the wilting will be temporary. With prolonged flooding, however, the leaves begin to turn yellow and die. Particularly in such cases, Drs. Kramer and Jackson have found, the wilting is helped along by certain toxic substances formed in the roots and carried to the tops.

Several factors will determine the severity of injury caused to the plant by flooding. In addition to length of flooding, temperature, certain types of soil organisms, and the rate of development of certain roots are important. High temperatures, for instance, decrease the solubility of oxygen in solution, so that oxygen starvation occurs faster.

Drs. Kramer and Jackson suggest that, as a solution to the wilting problem, strains of tobacco might be produced that require less oxygen and hence are more resistant to flooding. In the meantime, farmers might decrease injury from flooding by providing better drainage for tobacco fields.

Many Thousands to Get Polio Vaccine Next Year

Polio Vaccine Test

by JANE STAFFORD

▸ NEXT MARCH will probably see the start of the world's biggest trial of vaccination against infantile paralysis, or polio, short for poliomyelitis. This will be vaccination to prevent the disease, not gamma globulin treatment to ward off paralysis.

At that time hundreds of thousands of children will be getting "shots." Half of them may get shots of a new vaccine made to protect against all three known types of polio virus. The other half may get shots of some other, harmless material. It may be a salt solution, or it may be a vaccine of the kind many children get anyway, such as the shots against diphtheria, tetanus and whooping cough.

Only a few persons will know which children got which. When the 1954 polio season has come and gone, scientists will count noses to see how many in each group got polio.

This, roughly, is what can be expected on the basis of information now available.

"Definitive" planning is now being done for large scale testing of a polio vaccine to see whether it protects children exposed to the disease under natural conditions, that is during an epidemic, Basil O'Connor, president of the National Foundation for Infantile Paralysis, announced in New York.

At the same time Dr. Jonas E. Salk of the University of Pittsburgh reported to the American Academy of Pediatrics in Miami, Fla., that he has now vaccinated a total of 637 children and grown-ups.

The vaccine, he declared, is completely safe and capable of stimulating the production of antibodies against polio. These antibodies appeared in the blood within a few weeks and were still there three to four months later. In some of a group vaccinated earlier, antibodies against polio persisted for seven months.

Appearance of antibodies shows immunity to the disease.

Dr. Salk gave several different kinds of vaccines to the group. All were made from all three types of polio virus grown on monkey kidney tissue. This tissue, he finds, gives the greatest virus production. The virus is then chemically killed by formalin and mixed with either water or water and mineral oil. Some got one shot of vaccine and some got two or three doses at weekly intervals. Those vaccinated ranged in age from three years to over 21. They were "volunteers" and were residents of Allegheny County, most of them living in Pittsburgh suburbs.

This test of the vaccines was made between March and May, 1953. When the first polio case was reported in the county, in May, Dr. Salk stopped the trial. This was so any antibody rise could be held due to the vaccine and not to exposure to the disease.

Mr. O'Connor did not give any details of the plans for next year's large trial of the vaccine, but he did say the vaccinating would be done early in the year and in a non-epidemic period. This, with Dr. Salk's report, makes March seem the likely month, though February might be chosen.

Production of large quantities of virus for the trial is already under way and National Foundation authorities do not expect any shortage in this material from which the vaccine will be made.

Trial Changes Fund Policy

➤ PLANS for large scale trial of the new polio-preventing vaccine are changing the money spending policy of the National Foundation for Infantile Paralysis.

Next year one-third of the money raised through the March of Dimes in January will be forwarded to national headquarters to finance the new prevention program and to buy gamma globulin for temporary paralysis-preventing work.

The remainder of the March of Dimes funds will be divided 50-50 between the national headquarters and local chapters.

In the past all the March of Dimes money was divided 50-50 between headquarters and chapters. The chapter funds are used for local epidemic aid or to supplement national epidemic aid, while the funds going to headquarters are used for research, professional education and emergency aid to chapters.

The new prevention program is expected to cost $26,500,000, which means that a total of about $75,000,000 will be needed for 1954.

Polio Virus Sphere-Shaped

➤ THE POLIO virus is a very small, sphere-shaped particle, Dr. A. R. Taylor of Parke, Davis and Company, Detroit, has discovered through electron microscope studies.

It is so small that its diameter is only 30 millimicrons. One millimicron is equal to one twenty-five-millionth of an inch.

The virus measurements were made in connection with development of a polio vaccine and Dr. Taylor said that the work indicates the feasibility of preparing concentrated virus preparations necessary for the production of a vaccine.

He showed pictures of the virus at the recent meeting of the Electron Microscope Society of America.

Exchange Resin with Medicine

➤ AN ANION exchange resin is coming to the rescue of tuberculosis patients who find PAS (para-aminosalicylic acid) hard to take. The PAS is adsorbed on the resin and when the combination is swallowed, the hydrochloric acid in the stomach gradually displaces the PAS. As it passes into the intestine it is absorbed by the body and carried in the blood just as efficiently as if it had been taken alone. The new product is made by E. R. Squibb and Sons, who have tradenamed it Rezipas.

World's Most Powerful Atom Smasher Planned

"Colossatron" To Make Cosmic Rays

▶ THE WORLD's most powerful atom smasher, a 15-billion-electron-volt "colossatron," can be built in about three years for $6,000,000 to $8,000,000. Plans for the new giant atomic accelerator, which will mimic under man's control some of the power unleashed by cosmic rays, are being circulated among scientists for criticism by the design group headed by Dr. M. S. Livingston of Massachusetts Institute of Technology.

The proposed instrument, which the Atomic Energy Commission is being asked to build, uses the new, strong focusing principle worked out last year by a group of U. S. scientists. This will allow the "colossatron" to develop five times as much energy as the present world's largest atom smasher, the cosmotron at Brookhaven National Laboratory, which has an outside diameter of 75 feet.

The strong focus is developed by using many small magnet sections, rather than the larger ones now common, to focus the whirling atomic particles. The 15-billion range was chosen by the Cambridge Design Study Group, composed of scientists at Harvard University and MIT, because unleashing such energies would enable scientists to delve deeper into the heart of matter under conditions controlled by man.

The powerful cosmic rays bombarding earth from outer space have energies ranging from about two billion to several thousand billion electron volts. Where and when they strike, however, is not predictable, and their tracks are caught on photographic plates, sent 20 miles or so above the earth, only by chance. So, to get a better picture of the atom, man is building more and more powerful atom smashers.

The cosmotron has operated at 2.3 billion electron volts, and is expected some day to reach 3 billion, at the very lowest level of cosmic ray energies.

Officially the new machine is known as an "alternating gradient focusing synchrotron." The strong focusing idea was worked out last year by Drs. Livingston, Ernest D. Courant, Harland S. Snyder and John P. Blewett of Brookhaven, and was first suggested by N. Christophilos, a Greek citizen. By this method, the size of the magnet to accelerate to a given energy can be reduced very considerably. This is a saving of considerable metal, time and money.

The proposed machine will unleash protons, the hearts of hydrogen atoms and one of the building blocks of all matter. They will circle in a thin-walled metal tube, oval-shaped and only two by four inches in diameter. Diameter of the doughnut ring around which the cluster of protons is whirled would be 320 feet.

The ring consists of 48 sections of magnet, each 16 feet long, separated by gaps of five feet. Each magnet

section has equal lengths of diverging and converging focusing fields. These magnetic fields act on the protons in much the same way that convex and concave mirrors, used alternately, act to focus light waves.

As the protons whirl around the circular path, e'ectrodes, spaced 12 times around the ring, will kick the cluster to higher and higher velocities. Finally, as in all atom smashers, the protons will crash into the target under study.

The greater the energy of the bombarding particles, the more revealing such a smash-up is. By studying the disintegration products, scientists can learn new facts about the mysterious forces that hold atomic hearts together.

The U. S. scientists are cooperating closely with a European group known as the Council for European Research, Nuclear, or CERN, which is making plans for a 30-billion electron-volt accelerator, using the same principle, to be built in Geneva on a site already donated.

Volcano Ash Makes Cement

▶ WHEN a New Guinea volcano erupted violently in 1951 it produced ash that can be used in making cement, useful for construction purposes. Two specialists of the Australian government's scientific and research organization, K. M. Alexander and H. E. Vivian, communicated from Melbourne to the British science journal, *Nature,* the results of tests. These show that volcanic ashes from Mt. Lamington's recent explosion, when combined with lime, can be used in mass concrete work. The ash is what is called pozzolanic material. Tests on the ash blended with portland cement are also being made, since for some purposes such mixtures have been used successfully in other localities.

Glass Measures Radiation Dose

▶ PHOSPHATE glass has been developed to give a cumulative reading of the dose of atomic radiation a person has received over a period of time. The development has strong implications should America be ensnared in a hydrogen bomb war.

Now being made to U. S. Navy specifications by the Admiral Company, the glass glows in proportion to the atomic radiation it receives. When checked with a photosensitive device, the intensity of the glow reveals the amount of radiation that has registered on the glass. The device is designed to be worn in a small locket hung around sailors' necks along with their dog tags. Checking machines are to be within easy access of the sailor.

The glass measures amounts ranging from small, almost inconsequential, doses of radiation (about 10 roentgens) to doses considered past the fatal point (600 r).

Inexperienced personnel have learned to work the checking machine in less than five minutes.

Chemical Lack Seen Key To Disease Development

Chemical Factors and Diseases

▶ THE DEFICIENCY of a chemical agent in the human body may be a reason why some persons are more susceptible to rheumatic fever than others.

This is the clue being investigated by Drs. Forrest Adams, John Adams and David Imagawa of the University of California at Los Angeles School of Medicine under a grant from the Los Angeles Heart Association.

The chemical agent, known as an inhibitor, acts as a check against the over-activity of an enzyme, hyaluronidase. This enzyme breaks down protective jelly-like barriers of cells, permitting bacterial invasion. The inhibitor tends to neutralize this destructive action.

In families with a history of rheumatic fever there tends to be a deficiency of the enzyme inhibitor, which may be an inherited characteristic.

Rheumatic fever is invariably preceded by a streptococcus infection. However, many such infections do not result in rheumatic fever. Thus it is suggested that the combination of the inhibitor deficiency and a streptococcus infection may bring on the disease.

The relationship of influenza and other virus diseases to the onset of streptococcus infections is also being investigated. This may be another link in the causal chain of the fever.

Resistance to T.B.

▶ A CHEMICAL factor in the body seems to be important in resistance to tuberculosis, Dr. Quentin Myrvik of the department of microbiology of the University of Virginia Medical School has found.

Speaking as guest of Watson Davis, director of Science Service, on the Columbia Radio Network Adventures in Science program, Dr. Myrvik explained that research upon the enzyme, lysozyme, is expected to provide a means of measuring man's resistance and perhaps increase it when necessary to combat infection.

In the animal kingdom it is quite common to observe that one species of animal, such as the guinea pig, is susceptible to tuberculosis, whereas another species, such as the rat, is notoriously resistant, Dr. Myrvik said. A similar situation occurs in humans. A small percentage of humans appear to be extremely resistant to tuberculosis, whereas a corresponding group appears to be susceptible.

The studies in Dr. Myrvik's laboratory indicate that the enzyme called lysozyme may be important in these different states of resistance to tuberculosis. For example, the level of lysozyme in rat serum approaches the inhibitory level for tubercle bacilli. In contrast, the lysozyme content of the susceptible guinea pig is approximately one-fiftieth that of the rat.

The basic principle of the research program is to catalog, identify, and quantitate anti-bacterial substances which play a role in man's natural

and acquired resistance to infectious disease, Dr. Myrvik declared. Once this is established for diseases like tuberculosis, it will provide a means of measuring man's resistance, and perhaps altering it and raising it to its optimum. when infections ensue. Conventional bed rest therapy in the case of tuberculosis is an empirical method to accomplish maximum natural resistance of the individual.

Factors For Malaria

➤ WHAT ARE the chemical factors that make certain kinds of mosquitoes malaria-carriers and others not?

This is the research trail that Dr. Gordon Ball, University of California at Los Angeles zoologist, is following.

Using mosquitoes, canaries and culture flasks, he is attempting to trace the life cycle of the malaria parasite and the chemical factors that maintain the organism.

The cycle runs like this: When a malaria-carrying mosquito bites an infected canary, it may obtain the parasite in its sexual stage, which consists of male and female cells. These cells "mate" in the stomach of the mosquito and the fertilized cells then enter the wall of the mosquito's stomach and grow into round structures known as oocysts, which correspond roughly to fertilized eggs.

When the oocysts mature they break up into many organisms. This constitutes the infective stage of the parasite. These concentrate in the salivary glands of the mosquito and are transferred back to canaries the mosquitoes may bite.

For the first time egg-like oocysts have been grown in culture flasks. Living mosquito stomachs, to which oocysts are attached, can be maintained in a chemical medium for several weeks and the mosquito tissue continues to contract regularly as in life.

Clue To Better Drugs

➤ LATEST findings in research on the milk diet against malaria give hope that scientists will be able to find better drugs against not only malaria but other infectious diseases as well.

The original discovery, by Prof. B. G. Maegraith of the University of Liverpool, England, was that malaria in rats and monkeys could be suppressed by a milk diet.

This probably holds true for man also and may explain why babies in malaria-infested tropical regions do not get malaria, though older children no longer fed exclusively at their mother's breasts do. Human milk, Dr. Maegraith found, proved better than cow's milk for suppressing malaria infection in the rats and monkeys in his laboratory.

Adding para-aminobenzoic acid to the milk, however, causes the disease to reappear. This shows that changing conditions for the host affects the malaria parasite. This latest finding was reported to the British Association for the Advancement of Science.

From knowledge of metabolic activities and requirements it should, Prof. Maegraith says, become to a limited extent possible to perform our highly unnatural in vitro (test tube) investigations in vivo (in the living animal) in the natural conditions of the host.

His new method of research is expected to lead to study of infective

agents in natural environment and to a more logical approach to chemotherapy.

Cancer Blood Different

➤ RED BLOOD cells from cancer patients behave differently in their chemical activity than red blood cells from normal persons.

This finding was announced by Drs. Allen F. Reid, Richard C. Gilmore Jr., and Margaret C. Robbins of Southwestern Medical School, University of Texas, Dallas, Tex., at the meeting of the American Chemical Society.

It is in the handling of inorganic phosphate that the Texas scientists found the difference between the cancer and normal red blood cells.

Using radioactive phosphorus because it could be traced, they found that the red blood cells from cancer patients lost phosphorus at a faster rate than the cells from normal persons.

The studies suggest that normally there is a substance in the blood which checks the loss of phosphate from the red blood cells, and that cancer patients' blood has much less of this substance. The scientists also think that the red blood cells in cancer patients are more sensitive to standard amounts of this substance than normal red blood cells.

Cortisone For Rh Blood

➤ CORTISONE, famous for its relief of painful, crippling arthritis, has saved 75% of babies who otherwise would have died Rh blood deaths.

These "encouraging" results, obtained in 70 cases, were reported by Dr. Oscar B. Hunter Jr., of Doctors Hospital Research Foundation at a meeting of the Medical Society of the District of Columbia.

The cortisone is given to mothers who have previously had still-born babies because the Rh factor in the mother's blood was incompatible with that of the baby. It is given during the last three or four months of pregnancy.

When to start the cortisone treatment and what sized dose to give are determined by tests of excretion of two hormones from the mother's body. The hormones are 17-ketosteroids and pregnandiol, an end-product of progesterone.

By following the excretion of these two hormones during the last months of pregnancy, Dr. Hunter finds he can tell how the baby in the mother's womb is thriving. If it is not doing well, it is time to start the cortisone treatment of the mother. Subsequent improvement in the unborn baby's condition can be seen through the mother's hormone excretion.

Since he has been using this hormone check, Dr. Hunter finds he gets better results in helping mothers to deliver living babies.

Reason for giving cortisone is because it can prevent hypersensitivity reactions, which are what occur when mother's and baby's blood are not compatible in the Rh factor.

Lack of G.G. Found

➤ DOCTORS now know at least 14 patients who are completely lacking in G.G., or gamma globulin, blood substance famed for its use in fighting polio as well as measles and hepatitis.

The case of one, an otherwise normal nine-year-old boy, was reported

by Col. Ogden C. Bruton of the Army Medical Corps at a meeting of the Medical Society of the District of Columbia. Col. Bruton is chief of pediatrics at Walter Reed Army Hospital.

Besides reporting his case, Col. Bruton said that Dr. Charles Janeway of Boston had recently reported seeing five such patients and knowing of five or eight more.

Gamma globulin is the part of the blood that forms antibodies to fight various disease germs. Col. Bruton's patient had 19 attacks of blood stream infection, 10 of them caused by pneumonia germs.

Girls and women seem to escape this G.G. lack in their blood. At least, no case so far has been reported in a female. The condition seems to run in families. This is suggested by the fact that the mother of one patient said she had five brothers all of whom died of infection at an early age.

Whether these patients are born with this defect or get it some time after birth as a result of disturbance in the mechanism for forming gamma globulin is not known. Col. Bruton thinks the latter may be the reason, since his patient lived four and a half years without serious infection and only after that period began to have trouble.

Monthly doses of G.G. are keeping the lad in good health and free of germ poisoning.

Device Indicates River Pollution

➤ A NEW device giving a continuous record of river water pollution is now in use by scientists at the Academy of Natural Sciences of Philadelphia.

Called the Catherwood diatometer, it indicates what is happening to the aquatic life in a river by collecting and measuring the changes in the numbers and kinds of diatoms in the water. Diatoms are one-celled algae found singly or in colonies. They are a river's most widely distributed water plants, and an important food source for fish, waterfowl and other aquatic animals.

Polluted water has a very low oxygen content. Diatoms, one of the most active groups in reoxygenating the water, are good indicators of water conditions because the various species differ in their tolerance of pollution, Dr. Ruth Patrick of the Academy reports. Diatoms have cell walls of silica, and are thus easily collected and preserved. The new device consists of two buoyant metal balls supporting between them a ledge on which are placed the slides for collecting diatoms. The slides on which these plants collect when the instrument is suspended in water, Dr. Patrick reports, can be stored without special treatment and kept permanently.

Knowing the kinds of plants and animals in a river is fundamental to an understanding of how a river may be used but not abused. Stream survey teams directed by Dr. Patrick have studied rivers from the St. Lawrence to the Sabine River, Texas.

Hybrid Vegetables Possible Through Making Pollen Sterile

Bigger Vegetables by New Method

➤ BETTER QUALITY and bigger yields of onions, beets, carrots, rye, celery, swiss chard and many kinds of flowers will soon be available through a new sterile pollen mehod of producing hybrid seed.

W. H. Gabelman, University of Wisconsin horticulturist, reported to the American Institute of the Biological Sciences that pollen-sterile plants have been developed by special breeding. They are being used for hybrid production in plants not capable of being detasseled as in the case of corn.

When the seed plant develops sterile pollen, as can be caused now in some plants, the male element can be furnished by nearby plants that it is desired to cross-breed to create the bigger and better yields and quality.

The first hybrids by the new method to be available will be sweet corn, onions, beets, carrots and petunia.

Such plants as beans, tomatoes, peppers, peas, lettuce and wheat which are self pollinated probably will never be hybridized in this way.

In Mexico corn has been domesticated for thousands of years and ears among 25 distinct races range up to two feet in length. Now its native corn varieties have the chance of contributing their heredity to hybrid corn for the United States. This will be more productive and more resistant to drought, disease and insects.

Prof. Paul C. Mangelsdorf of Harvard University reported this prospect. Mexico's agriculture is benefiting from intensive study and development of corn. Since 1943 this study has been carried on by the Rockefeller Foundation and the Mexican government. Some Mexican corn races have been hybridized with a wild grass "teosinte" to produce hardier types that are resistant to drought and disease. This hybrid is especially promising for breeding purposes in the United States.

The growth-regulating chemical, maleic hydrazide, is being used to produce hybrid grain sorghum of superior qualities. Prof. Wayne J. McIlrath, University of Chicago botanist, predicted that if chemically suppressing the male flowers is successful an increase in production of sorghum as great as or greater than the success achieved in hybrid corn should be possible. The chemical sterilizes the pollen of the plant. Sorghum is as important a crop as barley.

Plasters or pastes of needed chemicals can be applied to fruit trees on their trunks and branches to give them food or to remedy nutritional deficiencies, such as zinc and magnesium. The idea of fertilizing by applications to scraped bark was first used a century and a half ago. It has been demonstrated effective in special cases by Drs. R. L. Ticknor, H. B.

Tukey and S. H. Wittwer of Michigan State College. Fertilizers can be applied in this way to sick and wounded trees, winter-injured or undernourished. This method should only supplement regular fertilizer applications to be picked up by the roots.

Plastic "Cans" Protect Bananas

➤ SOUTH AMERICAN bananas now are being "canned on the stem" for shipment in a transparent plastic film one-thousandth of an inch thick. Fruit producers and shippers alike have found that the protective wrapping preserves the lusciousness of the freshly harvested fruit. By holding in the fruit's moisture, the bakelite polyethylene film delivers the bananas to the consumer less dehydrated than those which are unprotected. The bananas also can be ripened to a brighter yellow.

Nuworld, American Cheese

➤ NUWORLD, an entirely new cheese variety, has been market tested and will be made available to housewives throughout the United States in the near future. It is a cheese of light cream color, soft buttery texture at room temperature, a flavor described as neither sharp nor mild, and an ability to blend with other foods smoothly and quickly.

Nuworld was given its name because of its American origins. It is reported to be superior in some respects to the traditional cheese types of Old World origin. It is an outgrowth of the development in 1942 of new cheese-producing organisms by Prof. S. G. Knight of the University of Wisconsin, tested in the University of Minnesota laboratories of Profs. W. B. Combs, J. J. Jezeski and Howard A. Morris.

Patented by the non-profit Wisconsin Alumni Research Foundation, proceeds from the patent will be turned back into scientific research.

L-Factor Helps Eggs Hatch

➤ A MYSTERIOUS L-factor investigated by a graduate student at Texas A. and M. College may save poultrymen millions of dollars each year by increasing the number of hatchable chicken eggs.

Bobby L. Reid has discovered that the factor, found in water-soluble liver concentrates and fish solubles, exerts a strong influence on the number of hatchable eggs a hen lays. Diets without L-factor reduced hatchability to 25% or less of normal, while the factor added to the diets increased hatchability to 10% more than normal.

It has been estimated that poultrymen lose $35,000,000 each year by setting eggs that do not hatch. Normally only 68 out of every 100 eggs hatch. If L-factor can be isolated and produced, it would reduce this loss significantly.

Chemical From Sugar May Fight 'Flu and Polio

Glucuronic Acid Tested Against Virus

▶ HOPE that a chemical from sugar may provide a defense against disease viruses, from 'flu to polio, is held by scientists at Yale University School of Medicine.

The chemical is a product of glucose when it has been burned, or oxidized, in the body. It is called glucuronic acid. It is also made synthetically and is relatively inexpensive. It is known to detoxify certain poisons in the body.

There is a chance, but no more than a chance, that it could be used to protect humans against virus diseases such as polio and influenza, says Dr. J. F. McCrea, one of the scientists who has been working on the problem.

The work so far, which he and Dr. F. Duran-Reynals are reporting in the journal, *Science*, has been limited to laboratory animals and to vaccinia virus (the cowpox virus used to vaccinate against smallpox) and influenza virus.

In mice there is definite evidence of prevention of influenza infection when these animals get 'flu virus treated with glucuronic acid dropped into their noses. Most control mice in the experiment who got untreated influenza virus into their noses died within two or three days with almost completely congested lungs as a result of the virus. The mice who got the treated virus almost all survived.

Whether glucuronic acid will stop polio viruses is not known yet. Unanswered also, so far, is whether the acid will be as effective in humans as in the laboratory mice. For human use, if that becomes a reality, it could be used in one of two ways: 1. Mixed with the virus to produce a good vaccine. 2. Given directly by mouth or by injection as penicillin or other antibiotics are given. For practical purposes it seems likely now it would be given directly. Vaccines take time to become effective after they are given, whereas glucuronic acid might take effect immediately. Even if its effect were only temporary, as is probable, it might serve to ward off a 'flu, polio or other disease attack when given in the midst of an epidemic. Vaccines usually must be given before the epidemic gets very far under way.

Discovery of glucuronic acid as a possible, though only possible, defense medicine against virus infection comes from earlier studies by Dr. Duran-Reynals. He found that cowpox virus could be inactivated by a body chemical called hyaluronic acid. This chemical is a component of the jelly-like mass which holds tissues together, which scientists term the ground substance.

The virus-inactivating effect of hyaluronic acid was markedly increased when this acid was treated with an enzyme chemical, hyaluronidase. The studies reported show that this is because treating the acid with the enzyme releases glucuronic acid.

Glittering Atomic Future
Far Off For Average Consumer

Atomic Power for Industry

by ALLEN LONG

➤THE INVISIBLE atom which now has so much attention focused upon it may light American houses in 10 or 15 years with electricity.

But because of radiation hazards, it is unlikely that atom-powered automobiles ever will cruise America's highways.

And since industrial development of the atom has hardly begun, housewives should not look for atomic vacuum cleaners under their Christmas trees for years to come.

These opinions from the Atomic Energy Commission help to clarify a picture in which the American taxpayer has nearly a $10,000,000,000 stake.

Today industry clamors to add atomic energy to its industrial muscles. But the government cannot release its atom secrets yet.

Legal entanglements of the present atomic energy law block the move. The need for security measures further complicates the situation.

The Atomic Energy Commission favors granting to private enterprise the know-how and permission to generate electricity by atomic power. Teams of industrialists have been working with the AEC on some of its closely guarded projects. They now heartily recommend that a government-financed pilot plant be set up soon. The pilot plant will let utilities learn more about the design and operation of future commercial atomic power houses.

The Joint Committee on Atomic Energy has called for hearings on the whole question of atomic power. It is believed that industry's role in harnessing the atom will be brought into better focus during the hearings. The date for the hearings has not been set.

One of the problems the committee probably will work out concerns the legal aspects of turning atomic secrets over to utilities who want to build atomic power houses. The present Atomic Energy Act prohibits anyone but the government from owning an atomic plant in which nuclear by-products are created.

This provision was written into the act to prevent unscrupulous industrialists from selling the radioactive by-product plutonium to the highest bidder — perhaps to an unfriendly nation.

Plutonium is an ingredient of nuclear weapons such as the A-bomb and H-bomb. Presumably it also goes into atomic ammunition fired by America's shiny new 280 millimeter atomic cannon. Deep in the silent heart of the nuclear reactor, plutonium is created in the atomic fuel U-238 as atoms break down.

Other fission products also are made during the silent chain reaction. Some of the products absorb neutrons shooting through the atomic fuel and will

stop the chain reaction eventually. That is why they must be taken out of the uranium from time to time.

The cost of this chemical separation is high. But by extracting plutonium at the same time and by selling it to the government, industrialists believe they can meet the expense of the separation process.

In fact, they believe they can make plutonium in up-to-date atomic furnaces, extract it and sell it to the government more cheaply than the government gets it now. But because of the high cost of extracting plutonium and impurities from the U-238, industrialists want assurance the government will buy the plutonium from them.

It appears that the government will need the by-product for years to come. By purchasing it from the utilities, the government thus would get the precious material and, at the same time, give industry the helping hand it will need.

Security is another problem surrounding industrial application of atomic energy. When they are built, atomic electric power stations will be the most modern plants in the country. They will incorporate knowledge gained from past experience with existing reactors. That will make them prime targets for espionage and sabotage.

Before the government will turn atomic secrets over to industry for commercial development, it must be assured that the enemy will not profit by the move.

If the problems can be ironed out, atomic electric power plants should spring up in 10 or 15 years.

The first plants probably will be built in remote areas now uneconomical to serve with electricity. This is because atomic power at first will not be able to compete successfully with electricity generated in coal, oil and water plants.

In those locations, the plants may prove to be economical. They could supply much-needed electricity to arid regions for irrigation projects, for instance.

The price of electricity created in atom-powered generators will be high. But in such arid regions where no electric power is available now at any cost, the high price tag will not play an important role. Even so, future refinements should lower atomic power rates eventually and put it in the same price bracket with conventionally generated power.

The future of the atom is fabulous. Although this era might be compared to the "Model T" stage in the atom's evolution, science has made it serve mankind. Already its influence has been felt in fields stretching from medicine to mechanics.

It has turned out materials that fight cancer, and it has revealed the cause of piston wear in automobile engines. It has pointed the way to crack-proof highways, and it has found cleaning disks stuck in underground oil pipelines.

The future undoubtedly will reveal many other jobs the mighty atom can shoulder to make everyday living more pleasant for Americans.

The first real atomic power plant now is being built by the Westinghouse Electric Corporation at the National Reactor Testing Station near

Arco, Idaho. It will power the U.S. Navy's first atomic submarine "Nautilus."

A land-based prototype of a second atomic submarine engine now is being developed by General Electric Co., at West Milton, N.Y. It will propel the Navy's forthcoming atom sub "Sea Wolf."

Facilities have been provided for the study and development of an atomic power plant for airplanes. Atomic engines for big ships, such as aircraft carriers, also are in the mill.

Atom-powered airplanes may be pushed farther into the future, however, because of the current budget-trimming project of the new administration.

Even if the development project is not hurt by reduced funds, atomic bombers probably will not sweep through the skies for many years. AEC Chairman Gordon Dean predicted last year that the first atomic plane would not appear for 10 years. Experts at Randolph Air Force Base, Texas, also report the plane is a long way off in reality.

It is unlikely that atomic engines ever will power automobiles unless some better shielding materials can be found to protect passengers from radiation hazards. Present shielding materials are too bulky to be satisfactory in autos, trucks and buses. However, atomic engines may pull great freight trains of the future.

Ever since the blinding flashes over Hiroshima and Nagasaki Americans have known that the atom has been harnessed. But they should not expect to find atom-powered vacuum cleaners and washing machines under the Christmas tree for many, many years. It takes time to develop a new idea into practical gadgets. And generally speaking, atomic scientists have not even tackled that task yet.

Solubility Important in Everyday Chemistry

➤ WASHING CLOTHES, baking a cake, brewing a cup of coffee and painting a house all involve solubility.

Dr. Robert Scott of the chemistry department at the University of California at Los Angeles, is investigating why certain substances will dissolve in one solvent but not in others.

In general things just naturally tend to mix, Dr. Scott explains. But some molecules are too "weak" to "elbow" their way in among the stronger molecules of other substances. This is why fluorocarbons, which have "weak" molecules, are relatively insoluble.

Insolubility is often just as important to the practical value of a substance as solubility. For example, insolubility makes fluorocarbons excellent materials for plastic containers.

Another solubility mechanism concerns the attraction of molecules to each other. When the molecules of one substance have as strong an attraction for those of another substance as they do for each other the two substances will form a solution.

Chemical Warfare Experts Work on "Red Tide" Poison

Red Tide Chemical Sought

▶ BACTERIOLOGICAL warfare experts in the Army Chemical Warfare laboratories have joined forces with biologists of the U. S. Fish and Wildlife Service to isolate the mysterious poison in the "red tides" which have killed billions of pounds of fish in the Gulf of Mexico in recent years.

Working on the theory that the Army specialists know more about poisons that anyone else in the country, Howard E. Eckles, chief of the marine fisheries section of the Fish and Wildlife Service, reports that scientists are shipping samples of Gymnodinium brevis, the microscopic organism which causes the so-called tide, from the Gulf to Camp Detrick for chemical analysis.

Rumors have circulated in Washington that the Army was interested in the organism as a possible instrument in bacteriological warfare. Mr. Eckles discounted the rumor entirely.

"We want to know what the poison is that kills the fish, and they have the equipment to find out," was his comment.

In 1949 some scientists advanced the theory that the fish were killed by the lack of oxygen in the water during the evil-smelling tide. This theory has been abandoned and biologists are now convinced that the organism gives off a poison which kills the fish.

The organism is neither a plant nor an animal but a kind of in-between "thing" technically called a dinoflagellate. Under certain conditions it suddenly bursts into bloom causing the fish-killing patches known as red tide.

Scientists in the Fish and Wildlife Service have on two occasions killed off small patches with copper sulfate crystals. One ton of crystals costing $275 will clear up a patch approximately three-quarters of a mile square. But this is effective only in the earliest stages of a bloom. When the patches grow to cover many square miles of the sea, the copper sulfate cannot be used to control the organism.

Albert Collier, a marine biologist, has found that the organism is usually present in water near the shore in non-poisonous concentrations. An unusually heavy rain or river run-off that lowers the salt content of the water, coupled with still air, are the conditions necessary for a bloom. During a bloom the number of individuals per quart of water explodes from 1,000 to 60 million or more, each about one-thousandth of an inch long. A squall or storm, which mixes the red tide patch with normal sea water, clears up the condition.

Scientists are now establishing a series of tests which will make it possible to detect the start of a bloom. Use of the copper sulfate crystals at the early stages may eliminate the problem in the future.

The organism's poison is so toxic

that winds blowing from the infested area carry an odorless vapor that causes irritations characteristic of very severe hay fever. When chemically treated, the thick water may be diluted as much as 1,000 to one and still kill fish in pools within an hour.

No evidence has ever been presented that the huge losses have affected the total fish population. The indirect economic effects to the tourist industry when tons of dead fish are piled on beaches and the health hazards have spurred on research work.

▶ "YOUR RIGHT—*it is an honest-to-goodness diamond!*"

Plant Cell Growth Controlled by Hormone

Growth of Plant Tissues

▶ THE EXTENT to which plant cells divide and grow is largely controlled by the production and availability of auxin, the plant growth hormone.

Processes of plant growth are being discovered in the plant physiology laboratories of Dr. Kenneth V. Thimann, professor of plant physiology at Harvard University. He is giving a national Sigma Xi lecture at various universities, in which he tells of his work.

Plant growth is studied by using sections cut from growing young seedlings which continue to live and grow for a few days in simple chemical solutions.

During this isolated period the growth processes are intensively investigated by the scientists. Dr. Thimann explains that growth in plants is a complex of many processes.

The increase in volume which is measured as growth in the isolated plant sections is due to the uptake of water in the plant cells.

Dr. Thimann has done experiments to determine whether the energy of respiration draws the water by pumping or by modifying the properties of the cell wall so the water seeps through. His experiments, which are still continuing, do not support the pumping theory.

The action of the hormone auxin in promoting growth by cell enlargement is accompanied by effects on many other aspects of plant life. Some tissues are stimulated to divide, others are stunted and under certain conditions, still others may be converted to pathological or diseased growths.

A thorough understanding of cell enlargement is essential for understanding many other aspects of plant life, Dr. Thimann said.

Ordinarily the term "growth" in plants refers to a complex of many processes: the uptake of nutrients, the synthesis of organic substances in presence of light, the transport of these substances from the cells in which they are made to those where they are metabolized, and the division and enlargement of these cells as a result of their supply of organic substances, minerals and water.

The extent to which cell division and enlargement take place is largely controlled also by the production and availability of auxin, the plant growth hormone. Progress can only be made in the study of growth, therefore, by isolating these constituent processes and investigating them separately. To a large extent this can be done by using sections cut from growing seedlings. These will continue to enlarge in simple solutions for a few days and will often grow almost as much as when on the intact plant. If the seedlings are free from chlorophyll, photosynthesis is excluded, and if the plants are raised under constant conditions and the sections carefully controlled, reproducible results can be obtained in which almost all of the growth is due to cell enlargement.

In some sections, such as those cut from oat coleoptiles, cell division is completely absent; in others it is at least reduced to a negligible quantity. The elongation of these isolated sections can thus be regarded as growth reduced to its simplest terms.

The first consideration is the auxin or hormone needed to catalyze the growth process. Until now it has been believed that the naturally-occurring auxin of plants is indoleacetic acid. Recent discoveries, however, have shown that several indole compounds, rather closely related to one another, occur in plants, and some of these act as auxins. Distinction can be made between them by both chemical and biological means. In addition, there are present in plants precursor substances, like tryptophane, which may be converted to natural auxins under the influence of enzymes. The present experiments indicate that plants have at their disposal three separate systems for converting tryptophane to indoleacetic acid, and the availability or otherwise of these substances may determine whether or not growth takes place in a particular organ of the intact plant.

The second consideration is the metabolism which underlies the growth process. Isolated sections enlarge only under aerobic conditions and growth appears to be dependent on the oxidation of pyruvic acid contained in them. A number of enzyme inhibitors, such as fluoride, iodoacetate, arsenite, and organic mercury compounds, which are known to interfere with such oxidation have been found to prevent growth.

By comparing the chemical changes taking place in tissues under the influence of auxin, with and without these inhibitors, the relation between metabolism and growth has been worked out, particularly in stem sections from the pea seedling. During growth sugars are used up, partly by oxidation and partly by conversion to cell wall materials. In addition, sugars are supplied from the metabolism of fats in the tissue. The conversion of fat to sugar is prevented by arsenite and fluoride in the identical concentrations in which they inhibit growth.

Amino acids are also converted to asparagine in the growing sections, and this reaction also is inhibited parallel to the inhibition of growth. The total consumption of oxygen, however, although it is slightly increased by auxin, is not reduced by the above compounds proportionately to their inhibition of growth.

Thus, although growth is linked to respiration, it is not "geared" to it. And it is evident that respiration can be "uncoupled" from the growth process to varying degrees. It is also evident that metabolic processes involving amino acid and fat metabolism as well as sugar consumption, i.e., in general the metabolism of organic acids, furnish the energy for growth and that the enzyme inhibitors bring about their effect through interfering with this energy supply.

Separate experiments have shown that the oxidations which allow growth are carried out by the enzyme known as cytochrome oxidase. This enzyme is inhibited by carbon monoxide and the inhibition is reversed by light. The growth of several types of seedlings is similarly inhibited, and

their growth is reinstated by white light.

The increase in volume which is measured as growth in isolated sections is due to the uptake of water. Simple water uptake can be studied in quite other types of plant material, especially slices of fleshy tissue such as potatoes. It has been shown that this process resembles the growth of seedlings in a great many respects. It is promoted by auxin and inhibited by the same compounds which inhibit the growth of seedlings. Even the reaction to carbon monoxide is similar. Evidently, therefore, water uptake resembles growth in that it requires the support of oxidation processes and is dependent on a supply of auxin

Water can be made less available to the cell by supplying it in the form of a solution of an inert compound. This solution yields water to the growing tissue only with difficulty. In this way it has been shown that inert salts or other dissolved substances can inhibit growth, and when they do so the oxidative metabolism is not being interfered with. Thus two quite different types of inhibition can be distinguished: interference with the energy supply and interference with the water supply. This in turn raises the problem of how energy can be expended to bring in water.

Two possible "machines" have been visualized for bringing this about, one in which the energy of respiration draws in water directly and one in which the respiratory process modifies the properties of the cell wall so as to reduce its resistance to water uptake.

To distinguish between these two processes is the aim of experiments still continuing. These are of two kinds. In the first place, plants not having the cellulosic type of cell wall characteristic of higher plants have been studied. In the second place, conditions have been adopted in which plant tissues can be exposed to auxin but water is not available to them; thus if the cell walls are being modified the absence of water should not prevent this, and, on subsequent exposure to water, growth should be accelerated. If, however, water is drawn in by a direct, metabolically-energized "pump," the period during which water is not available must be a period in which essentially no change takes place. The tentative conclusion from the present experiments is not in favor of the direct "pumping" mechanism.

Finally, it is pointed out that the influence of auxin in promoting growth by cell enlargement is also accompanied by effects on a great many other aspects of plant life; some tissues are stimulated to divide, others are inhibited, and still others may be—at least under certain conditions—converted to pathological growths. For this reason the final elucidation of the process of cell enlargement is essential for understanding many other aspects of the life of plants.

Adequate water for both domestic and industrial uses is a major problem to many cities.

The waste of raw materials in wood manufacturing industries is probably greater than in any other industry.

New Aromatics Plant For Eastern Seaboard

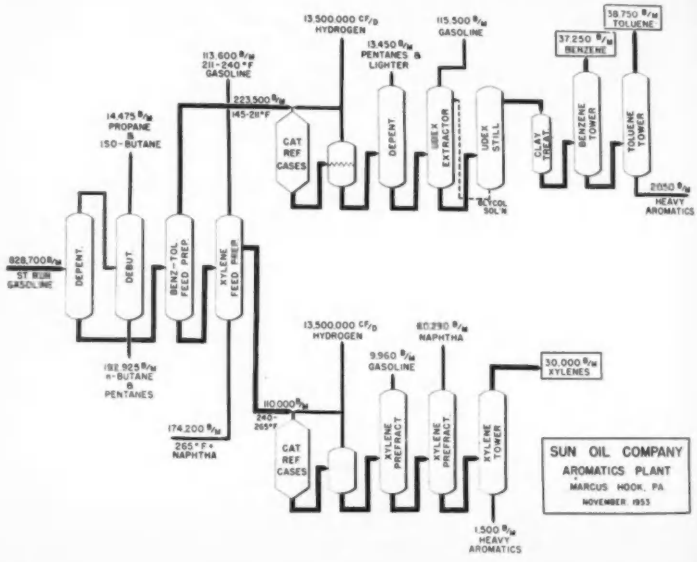
One-Finger Control For Refinery

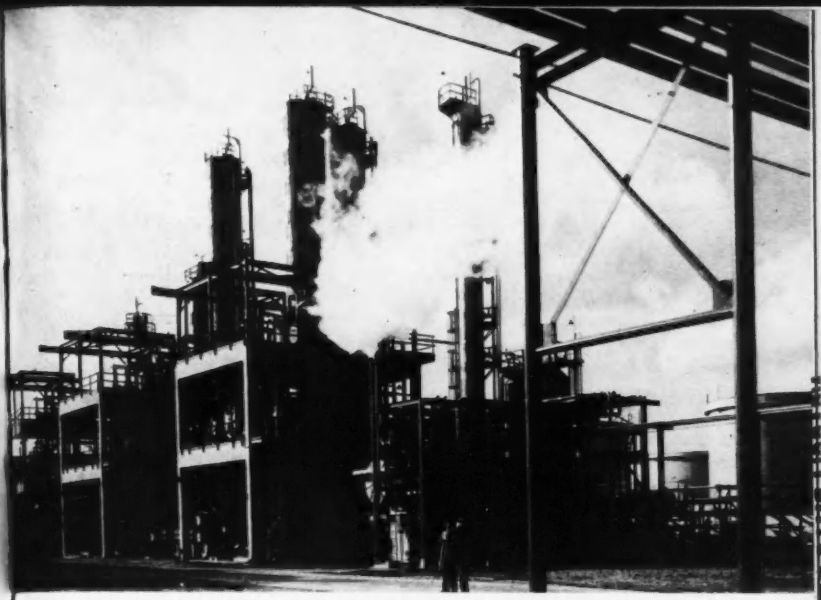
➤ WITH ONE-FINGER control the man in charge of operating the new petrochemical plant at Marcus Hook, Pa., can keep up with what is going on at every critical point in the maze of pipes, pumps, heaters and catalysts.

These devices change ordinary gasoline into pure hydrocarbons for pinpoint use in the chemical industry. The new installation by the Sun Oil Co. has just begun operation.

Service men no longer have to climb icy ladders in winter to read control meters, or squeeze between tanks in summer where reactions are taking place at 900 degrees Fahrenheit temperature. Sitting at a desk in the control heart of the new plant, the engineer uses one finger to dial station after station on the chemical production line. Meter readings from the instruments at those stations appear on the glass surface of the panel in front of him, with their messages. A glance tells him whether the chemical reactions are proceeding smoothly, or where to head off trouble before it starts.

Arranged to produce a choice of high grade motor gasoline or either of





➤ AROMATIC *chemicals of high purity will emerge from petroleum treated by the Houdry catalytic method. In the prefractionation section shown in this picture, feed stock is prepared for the catalyst tanks, which are shown on the back cover. The flow chart on the opposite page shows in outline the alternate processes for which Sun Oil Co's new plant is designed.*

two types of chemicals, the new plant uses 800,000 barrels of straight-run gasoline per month, some of which is casinghead gas. Careful regulation of temperature and pressure in reactors equipped with Houdry catalysts allows the plant to be run either for improved gasoline production or for manufacture of chemicals used for making dacron fiber or for phtha'ic acid, a valuable chemical of commerce.

Hydrogen, to the quantity of 13,000,000 cubic feet per day, is a by-product of the chemical operation, which produces either benzene and toluene or xylene as the main output.

On the Back Cover

➤ SUSPENDED *on ball bearings to accommodate expansion and contraction in the piping, the cylindrical tanks hold the catalyst that remakes petroleum in Sun Oil Co's new $15,000,000 plant at Marcus Hook, Pa.*

Glass

Bouquets of orchids to the lad or lass,
Whoever it was, who first made glass . . .

by Burton L. Hawk

➤ Like the wheel, glass is one of those substances known and used since the dawn of history. Archaeologists have unearthed objects made of glass which they claim were used by the Egyptians as early as 5000 B.C. It is remarkable that glass was prepared so long ago, when we consider that even today it is not the easiest product to manufacture. It is also remarkable that no major improvements were made in its manufacture until the present century. And only very recently have different types of glass been developed for diversified uses.

Glass may be considered a mixture of the silicates of certain metals, usually sodium, calcium or potassium. It is made by heating silica (ordinary sand) and sodium carbonate along with various other compounds depending upon the type of glass desired.

How to Prepare

There are several different methods to prepare crude glass in the laboratory. In all cases you should have a good source of heat. If a Bunsen burner is not available, perhaps you can take advantage of the gas flame on the kitchen stove. Use an old porcelain crucible for this reaction, as you will probably have to break it in order to remove the glass. Mix together thoroughly, by grinding in a mortar, one gram of powdered silica (fine, clean sand), one gram of powdered sodium carbonate and two grams of yellow lead oxide (litharge). Transfer the mixture to the crucible. Apply heat, gradually increasing until the mixture melts. Scrape off the scum from the molten mass with a glass rod and allow the crucible to cool. The glass hardens, forming a hard brittle layer on the bottom of the crucible. Do not expect your glass to be transparent. Very pure ingredients must be used in order to produce a clear glass. If you prefer a blue colored glass, add a small crystal of cobalt nitrate to the above mixture before heating. Add also a few drops of water to form a heavy paste. Then proceed as outlined.

If you do not wish to sacrifice a crucible for this experiment, you can try using a *hard* glass test tube instead.

Glass Bead

Another method to prepare glass is by using a wire. Take the wire, preferably platinum, and make a small loop in the end of it. Using a pliers, heat the wire in a gas flame. Then dip the hot wire into some powdered sodium carbonate. Heat the chemical in the flame until a clear bead is formed. Next take up some powdered silica with the hot bead and heat until the two compounds are fused together. Finally, dip the hot bead in powdered calcium carbonate and heat once more.

You will end up with a small bead of glass.

Is glass soluble in water? Grind a small piece of glass to a fine powder in a mortar. Be sure to protect your eyes during this operation. Add a few drops of water and a drop of phenolphthalein solution. Note the pink color, which indicates a small portion of the glass has dissolved.

Flint Glass

The first glass we have made is a type of *flint* glass. In a more refined form it is used to make lenses and cut-glass dishes.

The glass we made on the wire is ordinary window or bottle glass. It is called soda-lime or "soft" glass, because it is easily softened by heat.

"Hard" glass, with a higher melting point, is made by substituting potassium carbonate for the sodium compound. This glass is used in making laboratory glassware.

"Pyrex" glass contains compounds of boron in addition to the sand and soda. This type of glass (borosilicate glass) has a small coefficient of expansion and finds considerable use in the laboratory and in the kitchen.

Safety glass, used in automobiles, is made by placing sheets of plastic resin between two plates of glass and heating under pressure.

Colored glass is made by adding various chemicals to the batches. For example, selenium produces red glass, manganese forms violet glass, and chromium or copper produces green glass.

Newer uses of glass include glass bricks used for construction, and spun glass woven into fabrics.

Pure silica can be melted (about 1700 deg. C.) to form quartz glass. This glass does not crack under sudden temperature changes. You can heat a vessel made of quartz glass to white heat then plunge it into cold water without breaking. It is also transparent to ultraviolet light, which ordinary glass is not.

Borosilicate

One of the newest types of glass is sold under the name "Vycor." It resembles the quartz glass, but costs considerably less to produce. It is made from borosilicate glass. The borosilicate is treated with nitric acid, which removes most of the constituents except the silica. The remaining silica is subjected to heat treatment to obtain the finished product, which is actually 96% pure silica.

We certainly need not stress the importance and usefulness of glass. For over 6000 years it has stood alone as an irreplaceable product. Only very recently has it had any competition of any sort—that of the transparent plastics. Nevertheless, we feel that glass will still be around for a good many years!

Milk is America's greatest single source of calcium for the human body.

Practically all air in nature contains impurities, including windborne dust, pollens, odors and gases from natural sources.

The making of plastics is utilizing many former waste products of farms and forests.

Acid-Forming Elements
Some New, Some Very Old

Analyzing For All the Elements

Group V, a and b

➤ THE LIFE-GIVING elements, nitrogen and phosphorus, are essential in fertilizers for plant growth, and enter into many of the reactions necessary to animal life. Their determination is therefore frequently necessary when analyzing organic material.

Nitrogen is most frequently determined by the Kjeldahl method, in which it is converted to ammonia, distilled off, and collected in an acid solution of known strength. The amount of the acid neutralized by the ammonia can then be measured. For a quick method of determination, colorimetric comparison tests have been worked out also. Outfits for making these tests are available from laboratory supply houses.

Phosphorus, once believed present as an impurity, now known to be an important life element in its own right, causes complications in the standard analytical schemes. Its presence as one of the many acid radicals it can form may cause some elements to come down as unexpected precipitates. It may hold others in solution, only to have them appear later, when the metals in question were thought absent.

Determination of the presence or absence of phosphorus in an unknown substance is a wise precaution before embarking on the analytical scheme for finding the metals. Two standard methods are the precipitation of white magnesium ammonium phosphate or of yellow ammonium phosphomolybdate. Directions for these tests, for both phosphorus and nitrogen, are in standard books on qualitative analysis.

Arsenic

More metallic in its properties than phosphorus, arsenic can nevertheless parody that life-giving element in a series of corresponding compounds. But these cannot be used in a similar way by the living organism, and as a result the name arsenic is almost synonymous with poison.

Methods for determining the amount of arsenic in organic tissues have been well worked out, for medico-legal purposes, and are available in all standard manuals of analysis. In the qualitative scheme arsenic is precipitated by hydrogen sulfide from acid solution. The precipitate may be a mixture of arsenious (As_2S_3) and arsenic (As_2S_5) sulfides, with elemental sulfur also present. Heating and increase of acidity will tend to make the separation of arsenic from the test solution more complete.

Antimony

Although not so poisonous, antimony compounds are very similar in their chemical properties to the corresponding compounds of arsenic. Hydrogen sulfide precipitates sulfides of both valences, along with sulfur, from acid solutions, and the precipita-

Group V. Elements in Test Reactions

	HCl	H_2S	$(NH_4)_2S$	$(NH_4)_2CO_3$	Special Test
V. a.					
V	—	—	V_2S_5	—	Oxidation and reduction reactions
Nb	Nb_2O_5	—	Nb_2O_5	—	Spectroscope
Ta	Ta_2O_5	—	Ta_2O_5	—	Spectroscope
V. b.					
N	—	—	—	—	Kjeldahl test
P	—	—	—	—	Magnesium ammonium phosphate or ammonium phosphomolybdate
As	—	As_2S_5	—	—	
Sb	—	Sb_2S_3 Sb_2S_5	—	—	
Bi	—	(Prec. of Bi_2S_3 from slightly acid sol. with $(NH_4)_2S$)		—	

tion is said to be more complete if arsenic sulfide is present too, to act as a "carrier."

Slight differences in solubility between the corresponding compounds of arsenic and antimony can be used to distinguish between the two elements, and to confirm the presence of each when the other is present. Directions for these tests are commonly found in the analytical manuals.

Bismuth

The tendency of bismuth to form oxy-salts when its solution is diluted with water gives one set of tests for this element. Its sulfide forms from less acid solutions than those of arsenic and antimony. It may be precipitated for weighing as bismuth phosphate.

Vanadium

Vanadium is one of the unusual elements which have come to prominence only lately. It is found with uranium ores frequently enough so that it must be taken into consideration in modern rock analysis. It may occur in several different oxidation states, and the oxides corresponding to these states may take on a fascinating variety of colors. These oxides take on acid properties in solution. A series of vanadates may be formed, corresponding to the series of ortho-, meta- and pyrophosphates.

Vanadium sulfide may be precipitated by ammonium sulfide. For removing vanadium and other elements whose presence would interfere with determination of uranium in ores, the reagent *cupferron* and extraction with chloroform are used.

Analytical reactions may have for their purpose several different needs. At one time, the need may be mere detection, perhaps of very small quantities of the element tested for. At an-

other time, the purpose may be to recover all of the material present. Sometimes the amount of this material may be estimated without separating it. In another procedure, the analyst may wish to remove compounds of a certain element from the test solution because they may interfere with later tests. This could be the case with vanadium, on account of the colors its compounds show.

Niobium and Tantalum

Niobium, also called Columbium, is a very rare element, which was discovered in a mineral in the British Museum. The mineral came from America in the Plymouth Colony days. The name niobium has been favored as corresponding with tantalum, both names deriving from Greek legend. The two elements frequently occur together, and their chemical properties are so similar that their separation is very difficult. They may be precipitated with tannin, ignited and weighed, or extracted with cupferron and chloroform. Spectrographic methods will detect both elements in solution. From alkaline solutions, their oxides or hydroxides would come down in the course of analysis, but many other elements have the same behavior.

Transistor May Save Lives at Sea

➤ A TINY fleck of the metal germanium some day may save many lives at sea by sending out a radio beacon signal to guide rescue planes directly to persons in distress.

The germanium leaf, about two ten-thousandths of an inch thick, can be made into an oscillator that is attached to lifeboats. When in contact with sea water, the tiny device manufactures the radio signals to guide search-rescue planes.

This possible application of the germanium leaf was described by David B. Smith, vice-president of research at the Philco Corporation. Mr. Smith told the Franklin Institute and the Institute of Radio Engineers meeting at Philadelphia that this new germanium transistor also can be applied to electronic "brains." Most transistors so far have been restricted to "non-critical" tasks in hearing aids and other devices where the transistor's stability is not greatly important. However, the production of a transistor with reliable performance in high radio frequencies will open new civilian and military horizons to the tiny devices.

The new transistor, etched to its delicate thinness by two tiny streams of liquid indium salt, is said to work at frequencies up to 70 megacycles—which includes the military very-high-frequency communication band. It promises to make possible portable military communications receivers that work on only two flashlight cells. Because of the transistor's small size and its tiny power consumption, the military receivers can be shrunk to the dimensions of a cigarette pack.

Purdue University Host To Teen-Age Scientists

5th National Science Fair

▶ THE FIFTH National Science Fair will be held at Purdue University next spring. Already assured of drawing more than a hundred high school students from all over the nation, who have a bent for science, the three-day event is scheduled to begin on May 13.

All of the teen-aged scientists attending the national event will be finalists from local fairs held before April 24. They will receive all-expenses-paid trips to the fair, courtesy of their local sponsors.

Each finalist will display his scientific project that captured top honors for him at his local fair. While thus entered in friendly competition with boys and girls of his own age who are vying for a share of the awards valued at $1,000, he also will have a chance to receive expert professional and vocational counselling by some of the nation's leading scientists.

The young scientists will tour Purdue's campus and visit the research and engineering laboratories where students prepare for their future careers and where professional scientists are exploring the frontier of science.

They will tour the plant of National Homes Corporation, a company that makes prefabricated houses. The Aluminum Company of America will show the boys and girls how ingots of aluminum are extruded into complex shapes at Alcoa's Lafayette plant. The manufacture of Duncan electric meters, wired into many houses to keep track of the electric power used, will be shown to the young scientists also.

It is anticipated that a collection of models of Leonardo Da Vinci's scientific inventions will prove highly popular with the teen-aged scientists. Now on a nation-wide tour, this exhibit is scheduled for Purdue during the time the high school scientists will be there.

The National Science Fair has snowballed during its four years of existence. Its growth is reflected in new rules which restrict local fairs from sending more than two finalists to the national fair.

The 1954 fair also is unique in that the national event has grown to international proportions. Although one Canadian living in Pennsylvania entered last year's fair, this year hundreds of Canadians living in British Columbia are expected to participate in the local fair serving Washington, Oregon, Idaho and Montana. The Canadian entrants all will be eligible to attend the national fair if they capture top honors in the Spokane local fair.

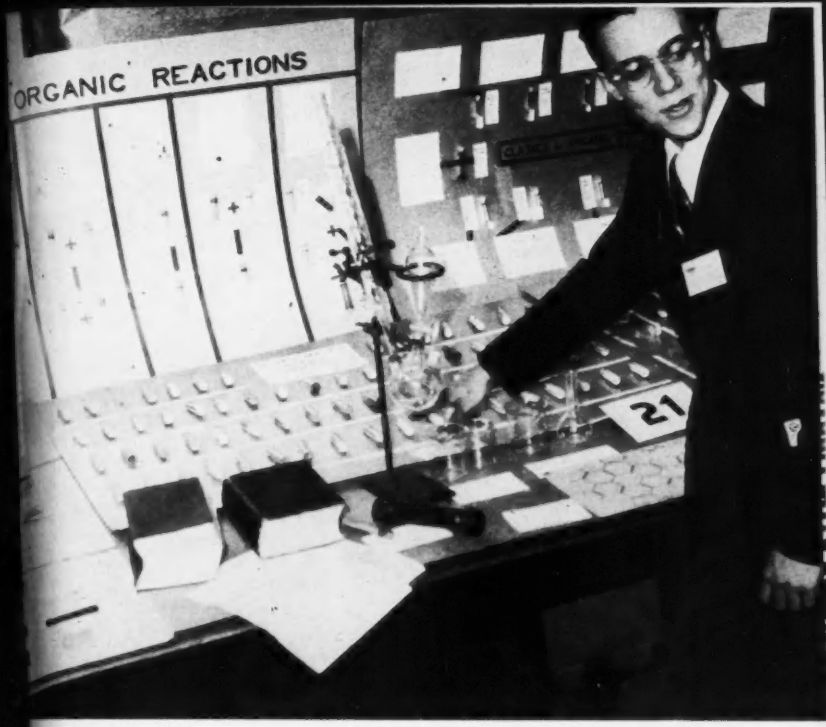
The entire science fair program is geared to encourage interest in science at the grass-roots level. The idea is to stimulate this interest in students of all ages. Some local fairs even accept kindergarten entrants.

Experience gained from past fairs

➤ ELECTRONICS *is the field selected by James R. Hougen, whose high fidelity recording and reproducing system was exhibited at the Second National Science Fair at St. Louis, Mo. His home is in Valley City, North Dakota.*

indicates that kindling interest in science in youthful students gives them a head start in life. They not only frequently chart their life's goal while still in high school, but also amass staggering amounts of knowledge pertaining to their chosen profession before they reach college.

Other students, upon seeing the ambitious projects undertaken by classmates, frequently up-grade their own goals in life. In some cases, this has



➤ THE FIELD *of organic chemistry was chosen by Rolf Engleman, Jr. of Oklahoma City. His exhibit of many compounds was shown at the Second National Science Fair, St. Louis, Mo.*

resulted in a switch from a proposed trade-school education after high school to a college education.

Adult reaction to the national and local fair programs has been equally heartening. Delegates to previous national fairs have come away sold with an unshakable faith in the worth of the program.

In some cases newspaper representatives have left with so much enthusiasm that they have pressed friends on other papers to spark the establishment of local fairs in their communities.

An official of one company which helped Science Service sponsor a previous national fair recently reported that his organization considers it to be the most important "outside activity" the company has ever undertaken.

Those interested in setting up fairs in their localities should write for complete details of the National Science Fair to Science Clubs of America, 1719 N St., N.W., Washington 6, D.C.

Girl Finds Conditions For Satisfactory Plating

Chromium Electrodeposition

by Lois Jean Frolen, *10th S.T.S.*

➤ Much has been accomplished in the field of electrodeposition of metals from aqueous solutions. There are many metals, such as copper, which are plated every day quite easily. There are other metals such as aluminum, magnesium and uranium which have never been obtained from aqueous solutions.

There are two types of cathodic electrodeposition:

(1) The type in which the metal produced at the cathode exists there in an electrically neutral and uncombined state. Examples of this type are silver, copper, nickel and chromium.

(2) The type in which the metal produced at the cathode exists there in a combined or ionic state or both. Sodium produced at a mercury cathode is an example of this type.

The primary concern of this investigation was to arrive at a satisfactory theory concerning the mechanism of chromium electrodeposition on a solid cathode (type 1 above).

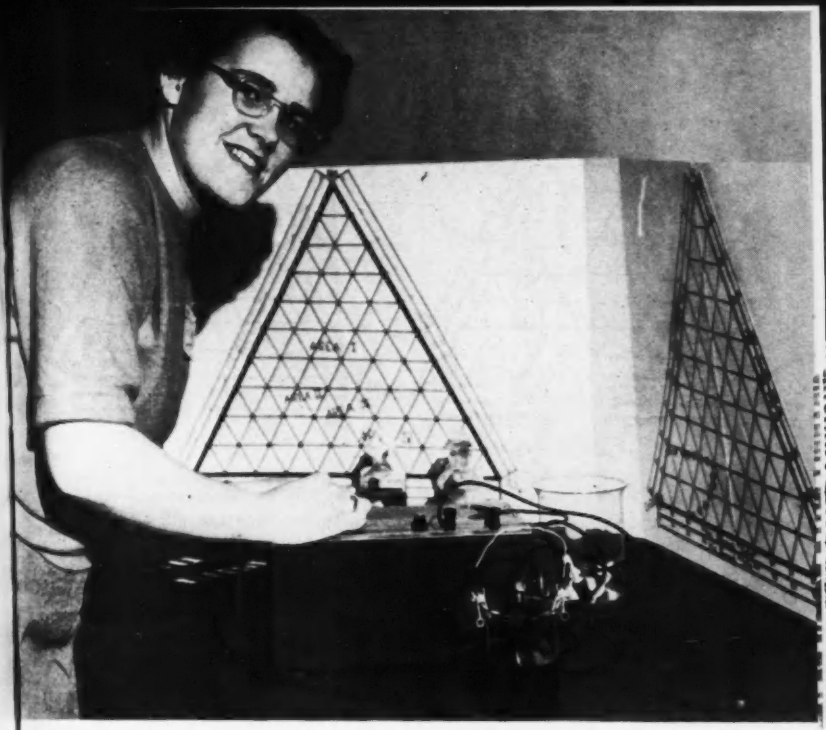
I chose chromium as the metal which I wished to investigate for two main reasons: (1) Acid electrolytes are easier to work with than alkaline electrolytes and their chemistry is much easier to understand. (2) In working with chromium, which is considered to be one of the harder metals from which to obtain a satisfactory plate, it was hoped to gain a better understanding of the easily deposited metals and also to touch upon the secret of the metals which have not been deposited from aqueous solutions.

Chromic acid solutions containing a little more than a trace of sulfate are usually recommended to obtain a bright deposit of chromium. Little has been published about increasing the alkalinity and the sulfate content of the bath. Therefore my first task was to determine the possible electrolyte composition range from which bright deposits could be obtained.

The chromic acid concentration throughout the experiments was 250 grams per liter. The compositions of the electrolytes (in weight percents) were plotted upon ternary diagrams with chromate, sulfate and sodium as the variables.

Figure I gives the percentage composition by weight of the electrolytes which produce bright deposits and figure II represents their composition on a molecular percent basis. In figure II some of the compositions are numbered so that they can be easily referred to in the text and the tables. *(See page 36.)*

The diagrams not only give the percent of each component, but they also give an indication of its pH. For example, 100% Na represents a pure sodium hydroxide solution, 100% CrO_4 represents pure chromic acid,



▶ CHROMIUM PLATING, *one of the more difficult problems in the deposition of metal coatings by electrolysis, was the challenge which Lois Jean Frolen of Eugene, Oregon, accepted as her science project for the Science Talent Search. Proportions of the sodium, sulfate and chromate ions in solution in the electroplating baths are worked out on her theoretical diagrams, and her results in terms of quality of the plated surface are indicated on these charts.*

and the points of the line between 100% SO_4 represent solutions containing both chromic acid and sulfuric acid.

For convenience in studying the results of electrolyzing the various solutions, figure I has been divided into areas: Areas I and II: No deposits were obtained from the solutions containing the constituents: NaOH + Na_2CrO_4 + Na_2SO_4 and Na_2CrO_4 + $Na_2Cr_2O_7$ + Na_2SO_4. Area III: Except when the concentration of chromic acid or sulfate or both is very small, all the solutions containing the constituents $Na_2Cr_2O_7$ + H_2CrO_4 + Na_2SO_4 give bright deposits until the solution becomes saturated with regard to one of its constituents.

No deposits at all are obtained from

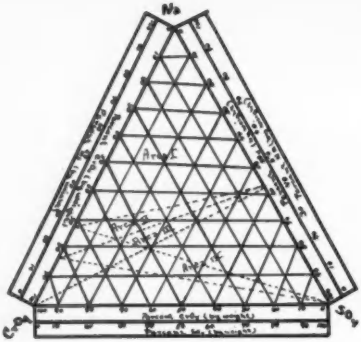


Figure 1.

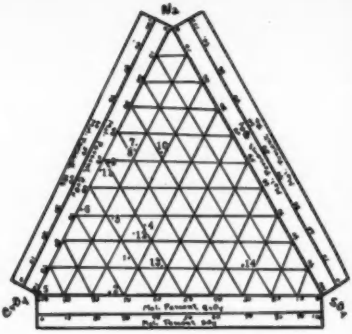


Figure 2.

a solution of pure $Na_2Cr_2O_7$. If Na_2SO_4 is added to this solution even to saturation, no deposit is obtained. If pure H_2CrO_4 is added to pure $Na_2Cr_2O_7$ solution, a fairly dark brown deposit is formed, which is generally considered to be chromium chromate. If Na_2SO_4 is added to this solution a bright deposit is formed.

Area IV: Combinations of H_2CrO_4 and Na_2SO_4 containing fairly small amounts of H_2SO_4 give bright deposits. As the amounts of H_2SO_4 are increased the plate becomes first frosty and then brittle and upon further additions no plate at all is obtained.

The mechanism of my experiments is as follows: The cathode in all of my experiments consisted of a brass plate 1 square inch in cross sectional area. The anodes consisted of two ¼ inch strips of lead which extend to the bottom of the cell. The cell which I used was a 400 cc beaker and the flow of current was regulated with a rheostat. A centigrade thermometer remained in the electrolytes during the entire course of the experiments and the temperature was not allowed to vary more than four degrees. It was found that the temperature could be kept within this range by the use of a Bunsen burner. However, when the temperature had to be exact during the entire 15 minutes of the procedure, a water jacket was used.

The following results were obtained from my work on the experiments:

1. From the figures I and II there appears to be a definite acidity range in which chromium deposits can be obtained. It was also observed that the acidity varies between that of pure chromic acid and a slightly acidified solution of sodium bichromate. When the solution contains a high concentration of Na_2SO_4, the amount of H_2CrO_4 must be increased. This is probably due to the tendency of Na_2SO_4 to increase the pH of the solution.

2. Electrolytes of varied compositions were investigated to determine the conditions which contributed to

Table I

Composition Number	*Current density amp./sq. in.*	*Temp. C°*	*Remarks*
2	1.75	22°	Narrow range for bright deposits. About same range as in case of 3.
5	1	50	Good bright deposit. Comparatively broad range.
6	1	50	Good bright deposits. Broad range.
11	.5	35	Good fairly bright deposit. Thick brown nonmetallic film which will not wash off unless scrubbed.
3	1.5	25	Narrow range for bright deposits. Broader than composition 11.
8	.20	22	Good fairly bright deposits. Similar to 11. Narrow range for bright deposits.
4	1.5	20	Very narrow range for bright deposits. Burnt edges and milky areas appear on the same sample.
10	.33	16	Very narrow range for bright deposits. Not below .25 amp./sq. in. or above .33 amp./sq. in.

the best deposits. The results are summarized in Table I. From this table it is clearly seen that, as the acidity of the solution increases, the cathode current density must also be increased to obtain a good deposit. Several of these electrolytes were investigated under special conditions (35°C at 1 and 1.5 amps./ sq. in. and 50°C at 1 and 1.5 amps./sq. in.) to determine the types of plates which could be obtained. The results of these experiments are summarized in Table II.

The conclusions which I have determined from my experiments are as follows:

1. In the case of each bath composition, each current density has a corresponding temperature range in order to obtain good bright deposits.

2. As the current density increases within the temperature range, the following types of deposits are obtained, in order, from the electrolytes of high acidity: i. No deposit, ii. Very narrow film of yellowish-brown material, iii.

Table II

Electrolyte Composition Number	1 amp/sq. in. 35°	1.5 amp/sq. in.	1 amp/sq. in. 50°	1.5 amp/sq. in.
1	No deposit	No deposit	Frosty around edges; no deposit in center.	Bright on edges no plate in center.
2	No deposit	No deposit	No deposit	No deposit
5	Frosty around edges remainder bright	Most of surface bright.	Good bright deposit	Good bright deposit
6	Frosty around edges remainder bright	Most of surface bright.	Good bright deposit	Good bright deposit
11	Center half covered with bright plate Brown nonmetalic substance covering a thin bright film.	Brown nonmetalic substance covering a thin bright film.	Brown non-metalic substance covering thin film on edges remainder bright.	Center covered with bright plate, rest covered with brown non-metalic substance.
3	Half of plate covered with a thin bright deposit, no deposit on the remainder.	Frosty at corners ⅓ of surface bright remainder no deposit.	No deposit	No deposit
8	No deposit	No deposit	No deposit	No deposit
4	Bright metal around edges; thin milky deposit on ⅓ of remainder. No deposit rest.	Edges slightly covered with milky deposit; no deposit on rest.	No deposit	No deposit

Milky deposit, iv. Good bright deposit, v. Frosty, vi. Peeled frosty deposit.

In baths of lower acidity when the current density is increased relative to temperature the following types of deposits were observed: i. No deposit, ii. Narrow film of yellowish-brown material, iii. Milky, iv. Good bright deposit, v. Brown nonmetallic material covering a very thin bright plate, vi. A very thin film of bright metal, vii. No deposit.

3. For each bath composition there is a temperature below which only dull deposits can be obtained.

4. When the bath has a very high acidity the current density range for bright deposits at high temperatures is often very narrow. But if the temperature is lowered this range broadens. Under low acidity the results are just the opposite, as the temperature rises, the range for good deposits also increases.

5. During chromium plating, the well known dark colored solution containing trivalent chromium continually moves away from the cathode.

6. Yellowish-brown material (probably chromous hydroxide) occurs in a narrow band (which varies in width with the acidity of the solution) on all of the cathodes not covered by the metallic deposit.

7. Chromium deposition is always

accompanied by the evolution of hydrogen at the cathode.

8. As the SO_4 content is increased, both the current density and the temperature must be lowered to obtain a bright plate.

9. When the cathode is withdrawn from the bath it is covered with a film which varies from a very easily removed, thin film to a heavy one which is almost impossible to remove.

There are many more things to be tested concerning chromium electrodeposition which I have not been able to touch upon yet. Perhaps as I continue with my experiments these things will be determined.

Doorknobs Retired in Simple Ceremony

➤ A PAIR of well-worn doorknobs was retired in a simple ceremony at Columbia University recently and placed in the University's Chandler Chemical Museum. The doorknobs came from the laboratory door of Dr. Colin G. Fink, an electrochemist, who died Sept. 16 at the age of 71. They were the first objects ever to be chromium plated in a successful commercial process.

Dr. Fink and his associates, one of whom was Vernon Burr, began exploring the possibilities of chromium plating in September of 1923, but the first successful plating operation did not come about until April 3, 1924, when Mr. Burr, a laboratory assistant to Dr. Fink, plated the doorknobs in a new solution worked out by Dr. Fink. The doorknobs were put into service to test their resistance to wear and chemical contaminants carried on the hands of students.

After 29 years of door opening, the knobs, dull in luster and worn bare in spots, are to be preserved for posterity.

New Mist Blower Passes Tests

➤ A NEW spraying device designed by the U. S. Department of Agriculture has successfully passed rugged tests at the Connecticut Agricultural Experiment Station at New Haven, proving that it can treat small orchards with insecticides economically.

The 200-pound machine can be mounted on a farm tractor, small trailer or pick-up truck, and is highly maneuverable. By means of a powerful air blast, it delivers tiny particles of highly concentrated insecticides to small plants and trees. Tests showed the machine is not suitable for treating shade trees more than 40 feet tall, but that it can easily handle nursery stock, row crops, grapevines and small fruits. It also can be martialled against insect pests and mosquitoes.

Mist blowers are said to hold an advantage over ordinary spray machines because mist blowers economize in chemical consumption and give better foliage coverage. This reduces labor needed for frequent refilling of the spray tank.

Small But Mighty Catalyst
Makes Big Molecules Out of Small

Size and Significance

Reprinted from FOR INSTANCE, *American Cyanamid Co.*

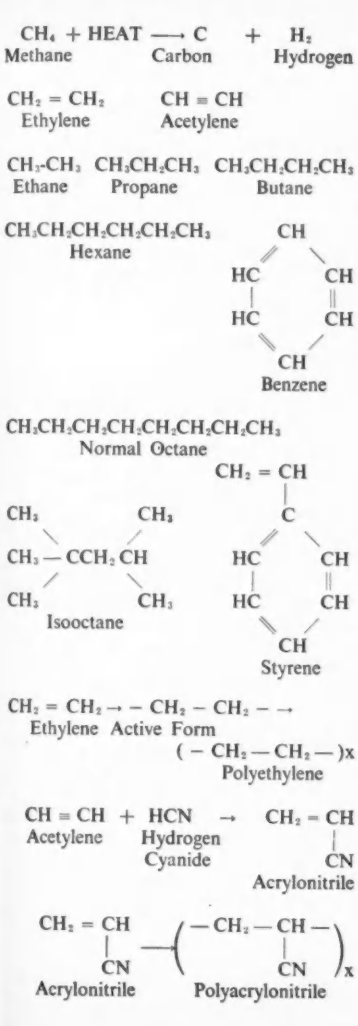
➤ ABILITY to convert crude natural resources into high-grade products at low cost is a yardstick of civilization, and a source of great wealth. Chemical engineering contributes greatly to this ability; chemistry reveals the fundamental units of matter, and engineering provides the tools to arrange and rearrange those units into a multitude of materials.

Primitive man used iron oxide mineral for decoration. We still use it for this purpose, but we also convert millions of tons of it each year into high-grade steels and fabricated articles. Wood is still used for canoes, but vast forests now disappear each year to reappear as houses, furniture, paper, cellulose plastics, and even guncotton. The conversion of crude petroleum oil and natural gas into a myriad of products is the latest and most fantastic metamorphosis wrought by chemical engineers. Oil and gas heat homes and fuel cars and planes, but also provide basic chemicals for synthetic rubber, fibers, plastics, drugs, dyes, and other organic compounds.

Chemically, oil and gas are hydrocarbons, i.e., composed of hydrogen and carbon atoms. There are many hydrocarbons each having different characteristics. Since they contain only carbon and hydrogen atoms their differences are due to variation in number and arrangement of these atoms. Why not develop techniques to rearrange the carbons and hydrogens so that hydrocarbons of low economic value be changed into more desirable ones? Chemists and engineers produced efficient catalysts and processes for "catalytic cracking" to break down big molecules, and the more recent "catalytic reforming" to change the shape of molecules. Catalysts are essential to these processes though 1% or less of catalyst is required. Catalysts initiate reactions, increase or decrease their rate and control reactions to produce specific products and reduce undesirable by-products. Good catalysts make possible higher yields of purer products, in shorter reaction time, and more favorable reaction conditions. Since the efficiency of catalysts depends on their physical form as well as their chemical composition, a variety of shapes, sizes, and compositions are now available.

A few typical hydrocarbons are shown in the diagram. Methane is the chief constituent of natural gas. In the absence of air at high temperature, methane breaks down to carbon and hydrogen. When this reaction is controlled with catalyst some carbons combine to form acetylene and ethylene. In catalytic cracking the large molecules in petroleum oils break down to small molecules such as ethane, propane, and butane. In districts without regular gas mains propane or butane are used as "bott'ed gas."

Typical Hydrocarbons



Hexane with 6 carbons, heptane with 7, and octane with 8 are found in naphtha and gasoline. In the "normal" condition their molecules are straight chains which are poor fuels for cars and planes; they have octane ratings of 26, 0, and —21 respectively. Fuels with high octane ratings permit high compression ratios in engines to obtain greater overall efficiency. Isooctane, with a branched chain structure, has an octane rating of 100, and is a highly efficient fuel. This year more than 12,000,000 gallons per day of "normal" will be up-graded by catalytic reforming. Mister American will reap the benefits when he "steps on the gas" and enjoys the extra power at his command.

This fortunate gentleman and his family also enjoy brightly dyed fabrics, plastics of all hues and shapes, and their health is protected with beneficial drugs. The basic chemicals for these (benzene and its relatives toluene, xylene, styrene, etc.) were obtained from coal tar, but its supply is limited. Why not adjust the "reforming" to split off some hydrogens and "cyclize" the chains to produce benzene, etc.? The change is simple on paper but new catalysts and reactors were necessary before it became today's reality.

Ethylene may be activated by catalysts then polymerized to form molecules having thousands of carbons per chain. Polyethylene is flexible and rubbery as you know from the popular polyethylene "squeeze bottle" containers, or its tough sheeting and packaging. Acetylene may be reacted with hydrogen cyanide to produce acrylonitrile. This important chemical may be polymerized like ethylene

but there is a big difference; the nitrile side groups (-CN) impart great strength to polyacrylonitrile. Therefore it may be spun into filaments for fibers like Orlon, or Fiber X-51. Acrylonitrile is the ingredient of nitrile rubbers which imparts resistance to oils and greases. It is being used in plastics and adhesives, and in many new chemical products.

Physical man is impressed by size; he is small compared with the earth, and insignificant in the universe. Through an attribute which has no physical dimensions he is subduing the earth to his control, is determining the composition of the universe, and is contemplating its possibilities for service to him. His ability to understand and to control is a truer measure of his significance than height or weight. Catalysts are in a similar category; without the 1% or less of catalyst the fantastic "crackers" and huge reactors are simply size without significance. Therefore, when we enjoy the products of science and industry, let us doff our hat to the small but significant catalyst.

Surface Area of Clay Particles

➤ ONE POUND of a common clay has a total surface area equal to 100 acres of land, M. L. Jackson and R. C. Vanden Heuvel, soil scientists at the University of Wisconsin, told the American Society of Agronomy and the Soil Science Association of America recently.

They reported on a new method for measuring the total surface area of particles in clay soils. This knowledge is important in the study of soils because nutrient elements and water are held on the flat surfaces of the particles. Clay samples are mixed with glycerol, the excess glycerol is removed and the amount remaining determines the surface area of the particles.

Using this method, they have found that an acre of land at plow depth with five percent montmorin clay has 10,000,000 acres of surface. This clay is found in many places.

Electronic "Stethoscope" for Metal

➤ AN "ELECTRONIC stethoscope" has been created to speed the close-tolerance finishing of metal.

The machine operator holds a small microphone on the metal being worked and listens through earphones to the amplified sounds of the metal being scraped away. The loudness of the sound is proportional to the amount of metal being removed. In addition to helping the machinist keep within his extremely close tolerances, this Minneapolis-Honeywell device also speeds metal finishing operations, reduces the number of pieces that must be scrapped and cuts operator fatigue.

The metal finishing operation is checked by an electronic comparator that is accurate to five millionths of an inch. The comparator works hand-in-glove with the stethoscope to prevent "over shooting" the limit.

Teacher Shortage Threatens Supply of Young Scientists

Science Teachers Wanted

➤ At the very time the number of children to be educated is increasing, the supply of new teachers is falling. Science students are most affected.

Alarming figures to prove this have just been issued by Dr. Ray C. Maul, assistant director of the research division of the National Education Association.

Only half as many science teachers (48.7% reduction) were graduated from college in 1953 as in 1950, Dr. Maul's figures show. The reduction in new mathematics teachers was 41%. For all high school teachers the reduction was 36%.

The greatest production of college graduates in any one year was in 1950, but even in 1950, Dr. Maul emphasized, "there was absolutely no oversupply of candidates for either mathematics or science teaching positions."

The reduction in teachers trained has occurred in the face of an even greater teacher need.

"An enormous increase in the total number of high school students to be educated is just around the corner," Dr. Maul warned. "For nearly two decades, the high school enrollment has been stable. Soon, the avalanche will come."

"In 1960 there will be three high school students for each two in 1950," his figures show. Because four years or more are required to produce a teacher after the would-be teacher graduates from high school, an even greater shortage is inevitable.

"The number and quality of the scientists of tomorrow are being determined in the classrooms all across the nation today," Dr. Maul explained.

"The science teacher is literally the key to the situation during the formative years in which concepts are grasped, abilities are recognized, interests are formed, visions are caught, and future plans are made."

Inadequate science and mathematics teaching will affect the future of America's leadership in trained scientists and mathematicians, Dr. Maul predicted.

The dwindling supply of qualified teachers now trickling from the colleges must be remedied, Dr. Maul declared, in order that:

1. Youngsters now about to enter junior high school will have the inspiration of a competent science teacher.

2. The American schools can sift the high school population for the next decade so that every student with scientific aptitude is to be identified and encouraged.

3. Our American society can be fortified two, three and four decades hence with leaders of resourcefulness, creative imagination, and a sound understanding of science.

Dr. Maul's detailed studies are presented in the journal *The Science Teacher*.

Inventors See New Ways To Use Old Materials

Chemical Materials Find New Uses

Order patents by number, enclosing twenty-five cents in coin, money order or Patent Office coupon (but not stamps) for each one. Address the Commissioner of Patents, Washington 25, D. C.

Ultrasonic Dishwasher

➤ SAMUEL BAGNO of Astoria, N. Y., told patent office officials that he is able to cleanse dishes without hot water, soaps, or even abrasives such as ordinary scouring powders. Furthermore, he reported he could attain a "relatively high degree of sterlization even when using domestic cold water."

He was describing his ultrasonic dishwashing method, now protected by patent No. 2,647,846.

Mr. Bagno's dishwasher consists of a tank that discharges to a drain. Water is fed into the bottom of the tank through a tube running to a faucet. The water is turned off and on at a rate of 20,000 to 40,000 times a second by a special device. This sets up tiny pressure waves in the tank which snatch food away from the utensils. The dishwasher makes no noise because the water flow is interrupted so rapidly that human ears ordinarily cannot hear it.

Weather Suit

➤ A ONE-PIECE, buoyant, heated weather suit has been invented by Hubert K. Shaw of Boston. It received patent No. 2,647,507. Intended for fishermen, aviators, skiers and yachtsmen, etc., the suit is made of a waterproof material and comes complete with a hood for the head.

Chemical units that generate heat when moisture is added to them can be included in the suit during severe winter weather. They can be suspended by long cords running into the foot portions of the suit, or they can be drawn up into the breast part. The suit traps body moisture to sustain operation of the chemical units after a little water has been added.

Self-Steering Torpedo

➤ AIRPLANE-DROPPED torpedoes can be steered to their targets by a new control system invented by Robert H. Hill, Anderson, and James H. Guyton, Kokomo, Ind., who assigned their patent, No. 2,647,707 to General Motors Corp. The torpedo depends upon light being emitted by the target. At night, it may be necessary to drop a flare near the target so the steering system will work.

Corrosion Preventive

➤ WHEN INTERNAL combustion engines are left idle for long periods after being used, their cylinder walls, pistons and cylinder heads frequently corrode. Although some preparations have been created to combat this situation, they have not been wholly satisfactory.

William Henry Adams and William Denis Ervine, both of Kingston,

England, have invented an improved corrosion preventive that is sprayed into the cylinders to give more lasting protection. Their composition includes a wax treated so that it clings tenaciously to the metal. Tests on several airplane engines in disuse revealed over a five-month period that the preventive yields almost complete protection.

The inventors assigned their patent, No. 2,648,643, to the Standard Oil Development Company, a Delaware corporation.

Activated Carbon Pellets

➤ HUGH RODMAN of Pittsburgh, Pa., has invented a method of making activated carbon, and of pressing it into spherical pellets that are hard, tough and abrasion-resistant. Activated carbon is specially prepared for use as a catalyst in speeding chemical reactions. Mr. Rodman assigned his patent, No. 2,648,637, to the Rodman Chemical Co., Verona, Pa.

Remote Control Bombing

➤ U. S. AIR FORCE pilots now can foist "suicide" bombing upon any enemy without having to sacrifice their lives.

An "apparatus for remote control bombing" patented by Delmer S. Fahrney of the U. S. Navy permits death-laden gliders to be towed near the target, released and guided by remote control to the bull's eye.

The scheme permits fighter planes to carry out bombing missions by towing small suicide bombers to the enemy. When in range, the pilot cuts the glider free. A television camera nestled in the glider's nose flashes pictures to the fighter pilot showing what is ahead of the glider. By watching his tiny TV screen, the pilot can guide the glider to an enemy ship or ammunition dump by radio control. The fighter pilot can trigger the glider's bomb load by remote control, or he can leave the detonation up to an impact switch built into the glider.

The remote control bombing system was granted patent No. 2,649,262 under Section 266 of the Patent Laws, which permits the government to use the invention without payment of royalties to the inventor.

Radiant Energy Director

➤ DRS. Ralph Bray, West Lafayette, and Karl Lark-Horovitz, Lafayette, Ind., received Patent No. 2,650,311 on a "radiant energy detecting method and apparatus" which they assigned to the Purdue Research Foundation, Lafayette. Designed to detect relatively small changes in light or heat, the method involves directing radiant energy upon p-type semi-conducting germanium. As the radiant energy grows stronger at the point contact electrode, the back-resistance to current flow diminishes. Eventually a point is reached where current flows "backward" more easily than it flows "forward." A trigger device can be used to signal this change.

Antivesicant Clothing

➤ A MARYLAND inventor has developed new chemicals to combat the hazards of mustard gas and other vesicants. Jonathan W. Williams of Hyattsville reports that the chemicals can be impregnated in protective clothing for troops that must enter a contaminated area. As vesicant fumes work inside the suit with the air that cools the soldier's body, the chemicals effective-

ly neutralize the vesicant so that the soldier is not burned.

Such antivesicant chemicals must not be harmful to the skin, and they should be stable to oxygen, water and sunlight. They must cause little or no increase in flammability or deterioration of the cloth and they must withstand laundering. Although many compounds containing reactive chlorine meet some of these specifications, Mr. Williams says his chemicals, described as tetrachloro disubstituted glycolurils, do a better all-around job. His patent is No. 2,649,389.

Glass Re-inforced Paper

➤ HENRY C. CRANDALL of Mosinee, Wis., has invented an improved reinforced kraft paper, such as cardboard and fiber board, which uses parallel strands of glass yarn to yield high tensile strength and smooth outer surfaces, both of which, he said, frequently are lacking in papers currently reinforced with manila, jute, silk and cotton. He assigned his patent, No. 2,653,090, to Mosinee Paper Mills Company, Mosinee, Wis.

Bombproof House

➤ A BOMBPROOF house has been invented that quietly sinks into the earth during an atomic attack.

To protect the occupants from deadly A-blast radiation, giant slabs of lead-lined reinforced concrete slowly cover the sunken house, leaving only the chimney and plumbing vent exposed.

The bombproof house retracts on a hydraulic lift into an underground concrete shell. Occupants can enter and leave by way of a stairwell that is uncovered when the concrete slabs close overhead.

According to inventor William Rowles of Santa Monica, Calif., utility connections are unaffected by the house's mobility. Water and gas enter through pipes that "jackknife" at their connections as the house goes up and down. A sump pump discharges sewage into the city system.

While the house is underground, an air conditioning unit pulls fresh air from outside and blows it through the house. An auxiliary gasoline-driven electric power plant is provided for emergencies.

The house itself is rectangular in shape and has a bowed, rather than an angular, roof. The house is conventional otherwise, even to its shingles or asphalt-paper roofing. Mr. Rowles' invention was granted patent No. 2,653,468.

Spanish Moss May Yield Household Wax

➤ FURNITURE WAX may soon come from Spanish moss which festoons trees of the Southland's swamps.

Freshly gathered Spanish moss contains a green colored wax amounting to 5% of the plant's weight. This wax is easily purified and gives a hard, glossy finish to woodwork and leather, comparable to commercial waxes. Drs. Seldon D. Feurt and Lauretta E. Fox of the University of Florida College of Pharmacy urge some industrial organization to explore this possibility for making use of the plant.

Book Condensations

SEMIMICRO QUALITATIVE ANALYSIS —Hervey Hubbard Barber and T. Ivan Taylor—*Harper,* revised ed., 404 p., illus., $4.50. Theoretical material is integrated with the laboratory work in this textbook for students who already have had training in general chemistry.

DISLOCATIONS IN CRYSTALS—W. T. Read, Jr.—*McGraw-Hill,* 228 p., illus., $5.00. An introduction to dislocations with emphasis on theories that apply directly in a limited area.

ELEMENTARY QUANTITAVE ANALYSIS —Ralph L. Van Peursem and Homer C. Imes—*McGraw-Hill,* 383 p., illus., $4.50. Textbook for premedical and preengineering as well as chemistry students.

CHEMISTRY OF THE LANTHANONS— R. C. Vickery—*Academic Press,* 296 p., illus., $6.00. The series of elements known as lanthanons (or lanthanides) is better known as "the rare earths." An appendix is devoted to yttrium, whose properties are similar.

CHROMATOGRAPHY: A Review of Principles and Applications — Edgar Lederer and Michael Lederer—*Elsevier,* 460 p., illus., $9.25. Representing a review of the chromatographic methods developed in the last decade. Papers are referred to which contribute to the development of new methods or to the aplication of chromatography to new groups of substances.

INTRODUCTION TO SEMIMICRO QUALITATIVE ANALYSIS — C. H. Sorum — *Prentice-Hall,* 2nd ed., 198 p., $3.50. Written for students who have a background of one semester of general chemistry and wish to study qualitative analysis in a one semester course.

NUCLEAR PHYSICS—W. Heisenberg —*Philosophical Library* 225 p., illus., $4.75. This book by a Nobelist is nevertheless intended for readers with no previous, formal training in physics.

DIALOGUE CONCERNING THE TWO CHIEF WORLD SYSTEMS—PTOLEMAIC & COPERNICAN — Galileo Galilei translated by Stillman Drake with foreword by Albert Einstein—*University of California Press,* 496 p., $10.00. The translator went back to the definitive Italian edition and includes a translation of Galileo's notes which he wrote in his own copy of the first edition.

New books in chemistry listed for readers' information. These or any other American books in print may be ordered through Science Service, Book Department, 1719 N St. N.W., Washington 6, D. C.

Send check or money order to cover regular retail price. If price is unknown, send $5.00 and change will be returned. We will pay postage in the United States.

Proudly Presented

➤ FLUID COKING is the name of a new process being offered to industries by the Standard Oil Development Co., 15 West 51st St., New York 19, N. Y. The process, it is claimed, will aid in use of low grade crude oils not now economically refined.

➤ WAX EMULSIONS for paper sizing, made and sold by Hercules Powder Co. under the name "Paracol," are described in a new technical booklet just issued by the manufacturer. Write for the booklet, or for special information on other uses of the wax, to Hercules at Wilmington 99, Del.

➤ COATED anhydrous monocalcium phosphate, in which the coating regulates the release of gas, is offered as a new leavening agent for self-rising flour by Monsanto Chemical Co. Marketed as "Py-ran," the new product, which gets away from the phosphate chemical's tendency to absorb moisture, is manufactured at Carondelet, Mo. For information about its use, write the Phosphate Division, Monsanto Chemical Co., St. Louis 4.

➤ USE OF carboxymethylcellulose in wallpaper adhesives, detergents, and other applications is described in a new booklet "CMC-CT" issued by the Hercules Powder Co., Wilmington 99, Del. Technical data on formulas and analytical methods is included.

➤ A THERMOPLASTIC resin-rubber blend developed by the Naugatuck Chemical Co. and marketed under the name Kralastic will be manufactured in a new plant now being constructed at Baton Rouge, La. This addition to the facilities now making this plastic will bring to the market by July 1954 a larger supply. The material has high impact strength at low temperature and is available in a wide variety of colors.

➤ METHYLON resins which can be used for container linings and coatings for chemical processing equipment are announced by General Electric as an addition to their existing line of coating products. They are designated by the numbers 75120 and 75121, and are said to lack the limitations usual in phenolic materials.

➤ CELANESE Organic Chemicals, including the ten new ones they have recently placed on the market, are described in a new list which the company is distributing. Technical bulletins on each individual chemical are offered prospective users. Write Celanese Corporation of America, 180 Madison Ave., New York 16, N. Y.